Virtual Learning

Physics

Centripetal Acceleration

May 5, 2020

Physics

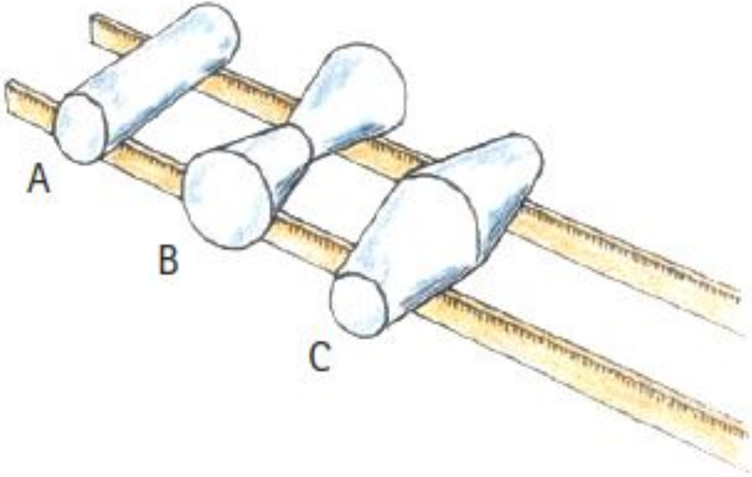
Centripetal Acceleration: May 5,2020

Objective/Learning Target:

Students will examine the concept of centripetal acceleration and use it to solve some basic problems.

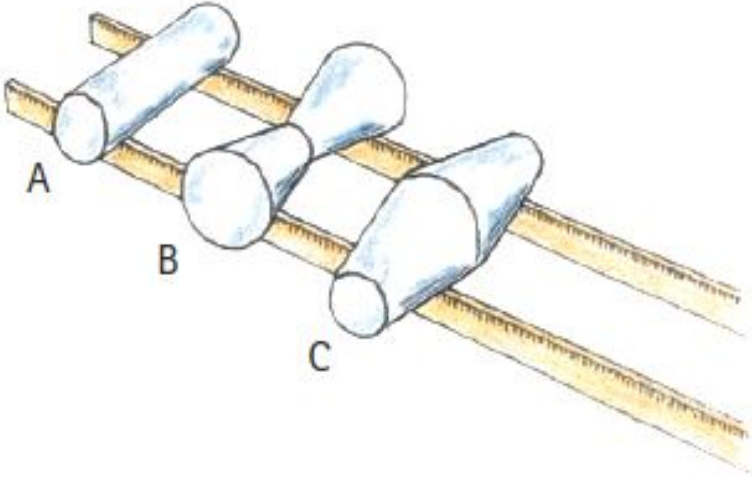
Quick Review #1

Three types of rollers are placed on slightly inclined parallel meterstick tracks as shown. From greatest to least, rank the rollers in terms of their ability to remain stable as they roll.



Quick Review #1 Answer

C, A, B



Quick Review #2

Three locations on our rotating world are shown. Rank these locations from greatest to least for the following quantities.

a. rotational speed about Earth's polar axis
b. tangential speed

Quick Review #2 Answers

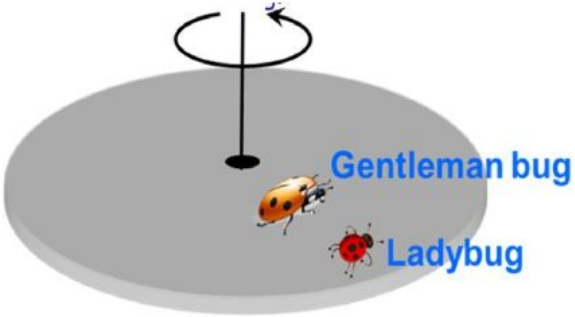
a. rotational speed about Earth's polar axis→ greatest to least

A = B = C

b. tangential speed→ greatest to least

C, B, A

Centripetal Acceleration



Link: Centripetal Acceleration

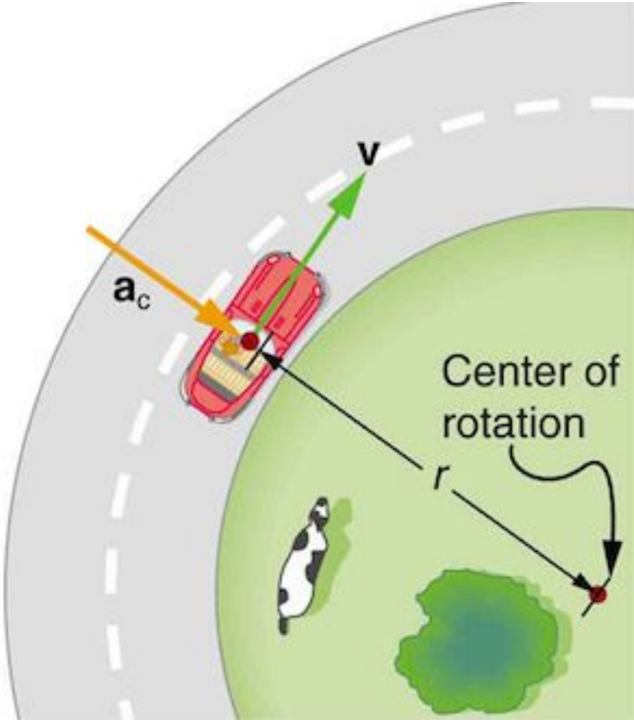
Directions:

- Read through Centripetal Acceleration.
- Work through any examples on a separate piece of paper before you scroll down to the solution.
- On a separate piece of paper complete the practice problems on the following slides.
- Check your answers.
- For additional practice check out the conceptual questions and the problems and exercises in the table of contents for the online text linked above.

Practice Problems #1

a. What is the magnitude of the centripetal acceleration of a car following a curve of radius 200 m at a speed of 30.0 m/s?

b. Compare the acceleration with that due to gravity for this curve taken at highway speed.



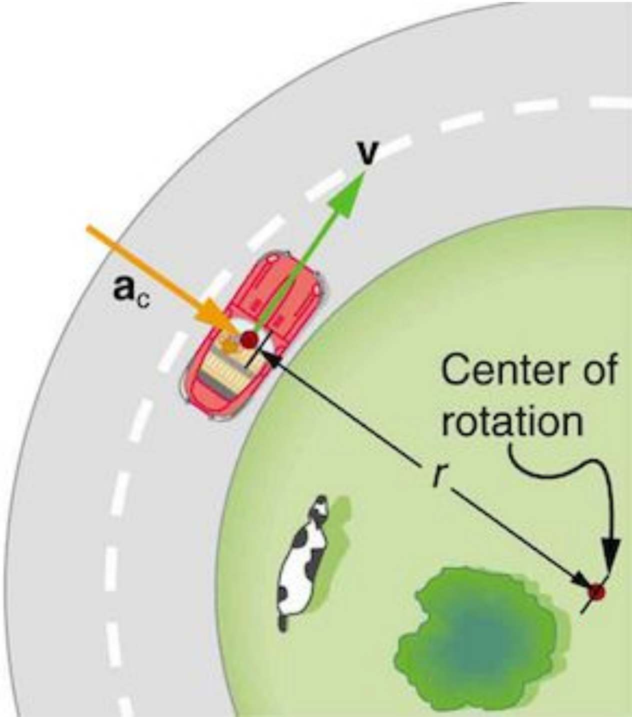
Practice Problem #1 Answer

a. $a_c = \frac{v^2}{r} = \frac{(30.0\ \text{m/s})^2}{200\ \text{m}} = 4.50\ \text{m/s}^2$

b. To compare to g we take the ratio:

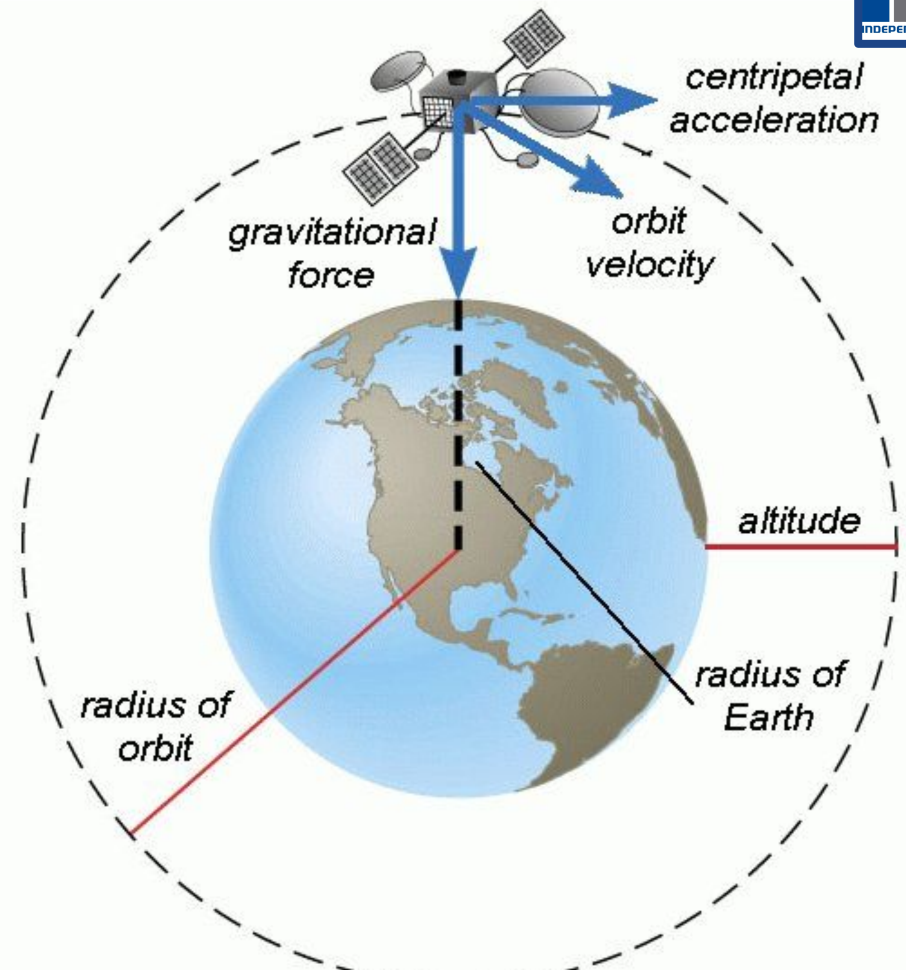
$$\frac{a_c}{g} = \frac{4.50\ \text{m/s}^2}{9.80\ \text{m/s}^2} = 0.459\ g$$

0.459 g is about half that of gravity, and very noticeable.



Practice problem #2

A satellite orbits a planet at 4.0×10^3 m/s , and the acceleration of gravity is 0.58 m/s^2. What is the diameter of the orbit?



Practice Problem #2 Answer

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

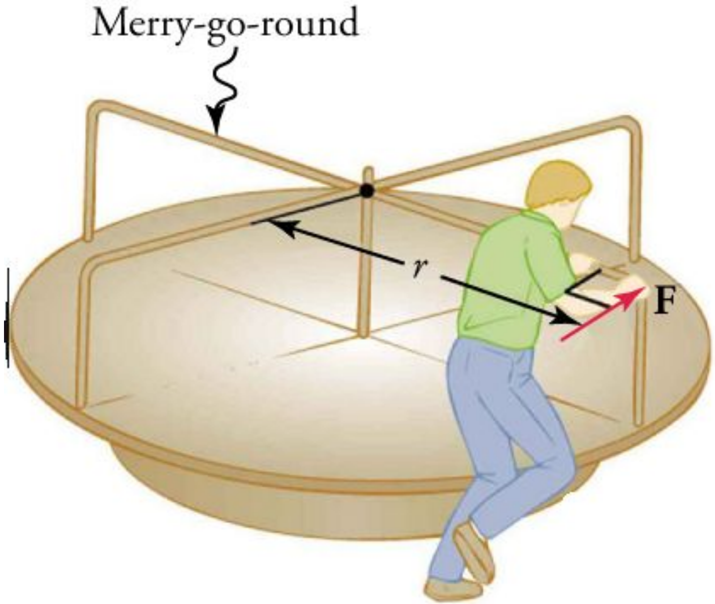
Rearrange for r.

$$r = \frac{v^2}{a_c} = \frac{(4.0 \times 10^3 \text{ m/s})^2}{0.58 \text{ m/s}^2} = 2.8 \times 10^7 \text{ m}$$

Diameter = 2r = 2 x (2.8 x 10^7 m) = 5.6 x 10^7 m

Practice Problem #3

How many revolutions per minute are needed to achieve 1.00 g of acceleration on a playground merry-go-round that has a radius of 1.75 m?



Practice Problem #3 Answer

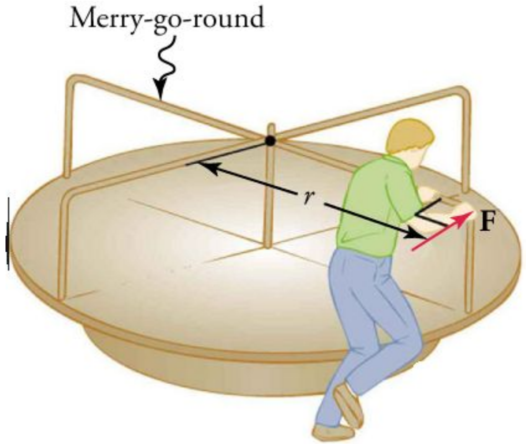
$a_c = r\omega^2$

Rearrange for ω

$\omega = \sqrt{(a_c / r)} \quad = \quad \sqrt{(9.80\ \text{m/s}^2 / 1.74\ \text{m})} \quad = \quad 2.37\ \text{rad/s}$

Now convert to rev/min

$$2.37\ \frac{\text{rad}}{\text{s}} \times \frac{60\ \text{sec}}{1\ \text{min}} \times \frac{1\ \text{rev}}{2\pi\ \text{rad}} = 23\ \text{rev/min}$$



Additional Practice

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