

Uniform Circular Motion

SYLL. STATEMENTS 2.4.1-2.4.4
DUE WED. 10/12

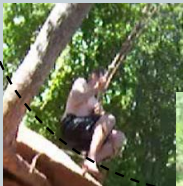
Warm-up Question (10.5.11)

- A dip in Sedona, AZ ...



- Why did his hands slip at the bottom of the swing?

Force diagrams for Matt at each point



- What forces are on Matt at the bottom of the swing?
- What is true about the direction of the sum of the forces on Matt during his swing?
- Why is it harder to hold on at the bottom of the swing?

Example Problem #1

- What multiple of his weight did he have to support with his arms at the bottom of the swing if his velocity at the bottom of the swing is 6.2m/s and his center of mass is 2.5m from the ropes point of rotation?
- Answer = 2.6 times weight

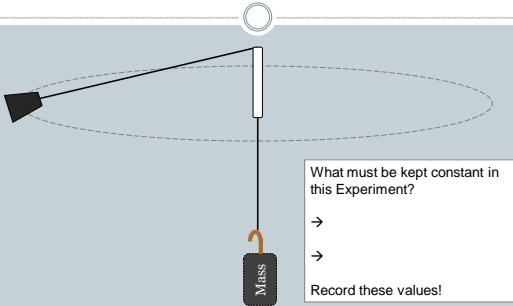


Circular Motion Lab

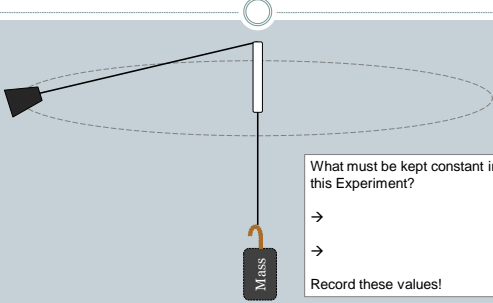
- What things other than his velocity might affect how much force Matt needs to be able to hang on to the rope? (*What things could be changed about this scenario that would affect the size of the force to keep him traveling in that circular path*)

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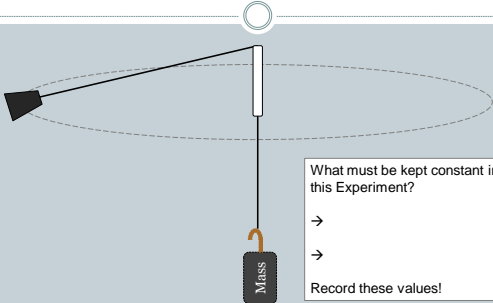
Find the Relationship between V and ΣF



or Find the Relationship between V and m_{stopper}



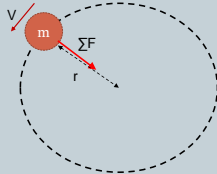
or Find the Relationship between V and r



Circular Motion Lab Results





- If the sum of the forces on an object is pointed toward a common center of rotation, perpendicular to its velocity, it will travel in a circle at a constant speed.

$$\sum F_c = \frac{mV^2}{r}$$



Force Diagrams:

- For each situation draw a force diagram for the object and identify the force / forces / component of force that contribute to the ΣF_c that causes the circular motion.

<p>1. Turning on a flat road.</p> 	<p>2. Turning on a frictionless banked curve</p> 
<p>3. Going over a hill (at the top)</p> 	<p>4. A satellite orbiting the Earth</p> 


Vertical Circular Motion Example

- What force is responsible for the sensation of being pressed into your seat on top of a roller coaster loop?
- How large is that force on a 90kg passenger if the loop has a radius of curvature of 5m and the coaster is traveling 9m/s at the top of the loop? What percent of the passenger's weight would that be?



Centripetal Acceleration

- Is the sum of the forces on you right now zero?
- What is your centripetal acceleration while standing on the equator of the spinning Earth?

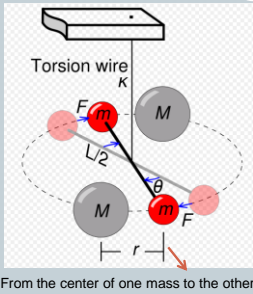


$$a_c = \frac{\sum F_c}{m} = \frac{mV^2}{m} \Rightarrow a_c = \frac{V^2}{r}$$

$$= \frac{\left(\frac{2\pi R_{earth}}{T}\right)^2}{R_{earth}} = \frac{4\pi^2 R_{earth}}{T^2}$$

$$= \frac{4\pi^2 (6.38 \times 10^6 m)}{(24 \cdot 60 \cdot 60 s)^2} = \boxed{-0.034 m/s^2}$$

Cavendish Experiment



Relationships:

$$F_g \propto \frac{1}{r^2} \quad F_g \propto m_1$$

$$F_g \propto m_2$$

$$F_g = G \frac{m_1 m_2}{r^2}$$

$$G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$$

Mass Determination of a Planet

- How do we know the mass of the Earth? ($5.97 \times 10^{24} \text{ kg}$)
- This value can be measured indirectly with any orbiting object.

$$M_{Earth} = \frac{4\pi^2 (R+d)^3}{GT^2}$$

