Warm Up: Centripetal Acceleration, Circular Motion, and Applied Forces

Prof. Jordan C. Hanson

October 18, 2022

1 Memory Bank

- $s = r\theta$ ... Let s be the *arc length* around a curve, with r being the radius of curvature, and θ being angle between the initial and final position vectors.
- $a_{\mathrm{C}} = v^2/r$ ... The centripetal acceleration given the speed v around a circular path r.

2 Uniform Circular Motion: Curved Coordinates

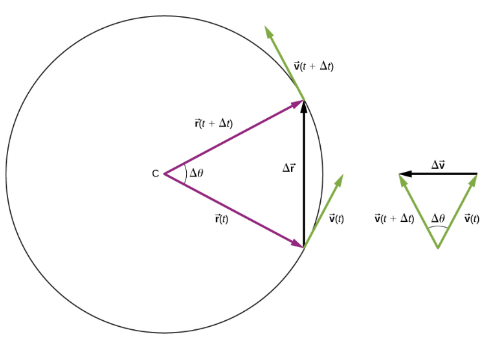
1. Suppose a circular path as a radius of 10 m. If we travel 10 degrees around the circle, how far have we walked?

2. If we walk 200 meters along a circular path, and later determine that our direction changed by 90 degrees (say, from North to West), what was the radius of curvature?

3. In Fig. 1 (left), a system moves in a circle with speed v. The velocity changes direction by an angle $\Delta\theta$, as does the position. It may be shown that this leads to *centripetal acceleration*, a_{C}. (a) If a system is moving at 4 m/s around a curve with radius 0.25 m, what is a_{C}? (b) What is a_{C} if $r = 1$ m?

3 Applied Forces, II

1. Assuming there is no friction on m_1 in Fig. 1 (right), derive an expression for the acceleration of m_2. Start with the free-body diagram of each block, and assume both blocks are accelerating.



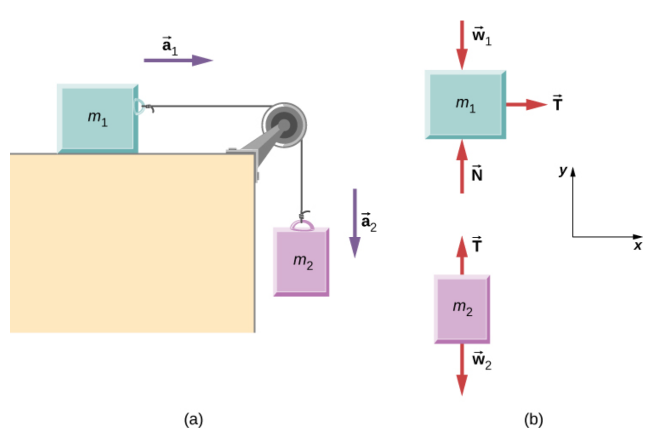


Figure 1: (Left) The origin of centripetal acceleration. (Right) A pulley system with two masses.