Friday warm-up: Forces II

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September 27, 2024

1 Memory Bank

- $\vec{v} = \Delta\vec{x}/\Delta t$, the definition of velocity.
- Newton's Second Law: $\vec{F}_{net} = m\vec{a}$. (The net external force on an object is equal to the mass of the object times the acceleration of the object).
- $s = r\theta$ ... 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.
- $a_C = v^2/r$ ... The centripetal acceleration given the speed v around a circular path r.s

2 Forces, II

1. In Fig. 1, a man with mass m and weight w stands on a scale in an elevator. Which of the followinng is true, if the elevator is accelerating upwards?
   - A: $w = mg$
   - B: $w < mg$
   - C: $w > mg$
   - D: $w = 0$
2. Suppose the man's mass is 60 kg. He is standing on a scale in an elevator that is *accelerating upwards* at 0.2 m/s^2. What is the weight on the scale?
3. (a) Suppose a circular path as a radius of 10 m. If we travel 10 degrees around the circle, how far have we walked? (b) If we walk 200 meters along a circular path, and determine that our direction changed by 90 degrees, what was the radius of curvature?
4. In Fig. 2, 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?

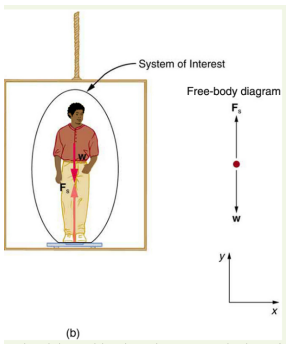

Figure 1: A person on a scale in an elevator.

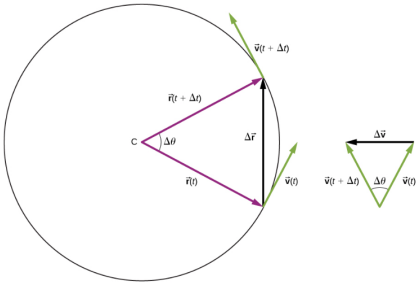

Figure 2: Uniform circular motion.

5. Assume there is a force of friction $-f$ on m_1 in Fig. 3. Derive an expression for the acceleration of m_2.

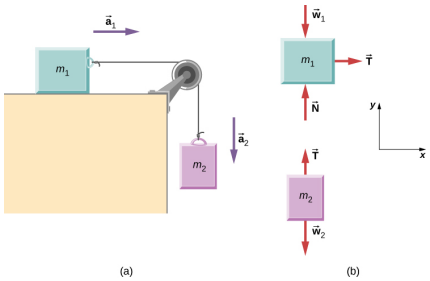

Figure 3: Friction acts on block m_1 and gravity acts on m_2.