1. (10 pts) A 25.4 cm diameter basketball dropped from the sunsphere reaches a terminal velocity of 19.5 m/s. The experimentally determined drag coefficient is 0.48 and the density of air at 20°C is 1.204 kg/m³. What is the weight of the basketball?

\[ F_D - W = 0 \]
\[ 0.568 \text{ kg} \times 9.8 \text{ m/s}^2 = 0.05067 \text{ m}^2 \]
\[ W = \frac{1}{2} \rho A C_D V^2 \]
\[ W = \frac{1}{2} (1.204 \text{ kg/m}^3) (0.05067 \text{ m}^2) (0.48) (19.5 \text{ m/s})^2 \]
\[ W = 5.57 \text{ N} \]

2. (10 pts) Abby is trying to pull a box full of portfolios. She pulls as shown but the box doesn’t budge. What is the magnitude of the friction force? (FBD required)

\[ F = 67.7 \text{ lb} \]

3. (16 pts) An airplane has an airspeed (with respect to the air) of 120 mph. How much time does it take to fly from Knoxville, TN to Terre Haute, IN with a 15 mph wind coming from the west?

\[ t = \frac{s}{v + w} \]
\[ s = 360 \text{ mi} \]
\[ v = 120 \text{ mph} \]
\[ w = 15 \text{ mph} \]
\[ t = 3.17 \text{ hr} \]

4. (16 pts) A car starts from rest and starts driving around an 88m radius circular track. It accelerates at a constant rate and after one-fourth of a lap its speed is 32 m/s. What is the car’s total acceleration at that point?

\[ a = \frac{v^2}{r} = \frac{(32 \text{ m/s})^2}{88 \text{ m}} = 11.63 \text{ m/s}^2 \]

\[ a_{total} = \sqrt{a_x^2 + a_y^2} = 12.2 \text{ m/s}^2 \]
7. (16 pts) A football is kicked as shown. How much time does it take the football to go from point 1 to point 2?
(assume negligible air resistance)

\[ t = 4.74 \text{ sec} \]

6. (16 pts) A 42 gram ball on a string rotates about a vertical axis at a constant angular speed as shown. What is the angular speed?

\[ \omega = 3.47 \text{ rad/s} \]