1. Determine the linear approximation of \( \sin(x) \) at \( x = 0 \). Use the graph of the function and its linear approximation to determine when this approximation is an overestimate of \( \sin(x) \) and when it is an underestimate.

2. Estimate \( \sqrt[3]{81} \). Is your estimate an underestimate or an overestimate?

3. (Section 3.10, Problem 35) The circumference of a sphere was measured to be 84 cm with a possible error of 0.5 cm. Use differentials to estimate the maximum error in the calculated surface area.

4. A window has the shape of a square surmounted by a semi-circle. The base of the window is measured as having width 60cm with a possible error in measurement of 0.1cm. Use differentials to estimate the maximum error possible in computing the area of the window.
5. A runner sprints around a circular track of radius 100m at a constant speed of 5 m/s. The runner’s friend is standing at a distance 200m from the center of the track. How fast is the distance between the friends changing when the distance between them is 150 m? Start by drawing a picture! Hint: you will need to translate the speed of 5 m/s into a rate of change for the angle between the runner, the center of the circle, and the runner’s friend; the rate of change should be measured in radians/s.