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1. Consider the integral  $\int_0^3 \pi(3-h)^2 dh$ , which gives the volume of a region in space. Sketch the region, showing all relevant variables and lengths and the slice used to write the integral. (3 points)

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2. Suppose that you are considering a career as a modern mathematical artist specializing in three-dimensional sculpture. Your latest work is to be a piece set on a base described as the region bounded by  $y = e^x$ ,  $y = 2e^{-x}$ , and the  $y$ -axis. The cross-sections of the piece perpendicular to the  $x$ -axis are semi-circular. Sketch a representative slice and set up an integral to find the volume of the region. For a bonus point, evaluate the integral analytically (that is, by hand). But do #3 first. (3 points)

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3. Find the area of the region between  $r = \cos(\frac{\theta}{2})$  and  $r = \sin(\frac{\theta}{2})$  that lies in the first quadrant. (4 points)