Show all work, including mental steps, in a clearly organized way that speaks for itself. Use proper mathematical notation, identifying expressions by their proper symbols (introducing them if necessary), and use arrows and equal signs when appropriate. Always simplify expressions. BOX final short answers, LABEL parts of problem. Keep answers EXACT (but give decimal approximations for interpretation). Indicate where technology is used and what type (Maple, GC).

1. \[ \int_0^{\sqrt{4x-x^2}} \int_0^x y \, dy \, dx \]

a) Re-express this integral in polar coordinates, providing an x-y plane diagram of the region of integration including labeled cross-sections representing the original and final iterated integral.

b) Evaluate the new integral by hand.

c) **Optional:** Does your result agree with the technology result for the original integral?

2. The surface \( p = 2 \sin(\varphi) \) describes a torus (donut) revolved around the z-axis with its central hole shrunk to a point.

a) Showing an \( \varphi - \rho \) plane diagram, iterate the triple integral which gives its volume.

b) Evaluate all the \( \varphi - \rho \) part of the integration by hand, since it leads to a trigonometric integral for which technology is required.

c) **Optional:** Can you finish the evaluation with technology? If so, what is the exact result?

Cutaway view of half the torus, cut along x-axis: