1. Write down a parametrization of the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ that traces the ellipse in the counterclockwise direction.

2. Write down a parametrization of the ellipse $\frac{(x-2)^2}{3} + \frac{(y+1)^2}{7} = 2$ that traces the ellipse in the clockwise direction.

3. Find the area of the ellipse in (2) using the parametrization you found.

4. Write down an integral that represents the arc length of the ellipse from (2), using your parametrization.

5. What are the slopes of the tangent lines to the ellipse from (1) at the points where $x = 1$?

6. What is the volume of a cone in terms of some simple linear measurements of the cone?

7. You have a horn with circular cross-sections whose radii grow linearly. Come up with a formula that gives the volume of such a horn in terms of some simple linear measurements of the horn. The formula should be easy enough for any high schooler to compute the volume of a horn, even if it's a wacky horn like

8. Compute the following integrals.

   (a) $\int_0^t xe^{-x^2}\,dx$

   (b) $\int_0^t e^{-x^2}\,dx$

   (c) $\int_0^t x^2e^{-x^2}\,dx$

   (d) $\int_0^t xe^{-x}\,dx$

   (e) $\int_0^t x^2e^{-x}\,dx$

   (f) $\int_0^t x^3e^{-x}\,dx$

   (g) $\int_0^\infty e^{-x}\,dx$

9. More integrals!

(a) $\int_0^y \sin^{23}(x)\cos^3(x)\,dx$

(b) $\int_0^y \cos(4x)\cos(8x)\,dx$

(c) $\int_0^y \cos(643x)\sin(x)\,dx$

(d) $\int_4^y \frac{1}{(x+1)(x-3)}\,dx$

(e) $\int_0^y x^3\sin(x)\,dx$

(f) $\int_0^y x^2\cos(2x)\,dx$

(g) $\int_0^y \sin(e^x)\,dx$

10. How do you go from the Cartesian coordinates of a point (x, y) to the polar coordinates?

11. So if you're given a polar curve $r = f(\theta)$, how do you get a parametrization of the curve?

12. Using the above information together with your knowledge of areas of parametric curves, write down the integral for the area contained by a closed polar curve. (You should be able to do this in general, but you may use the example curve $r = \cos(\theta) + 1$ as an example.)

13. A certain solid has a flat circular base with radius 3 in the xy-plane, and the cross-sections perpendicular to the x-axis are equilateral triangles. What is its volume?

14. Compute the area of the region inside the ellipse from problem 1 by computing an appropriate double integral.

15. Consider the differential equation $y' = xy$, $y(0) = 1$.

    (a) First, just for fun, fake the plot of the differential equation using Euler approximation with jump size 1.

    (b) Find the solution to the differential equation.

    (c) Sketch the plot of the actual solution, and compare with your faked plot.

16. Centroid something something
17. Normal distributions something something
18. Integration by differentiation
19. Pictures!