

**Problem 1.** Write polar equations for

- (a) A circle.
- (b) An ellipse.
- (c) A clover-shaped path (without using trig functions!).

**Problem 2.** Write down the following formulas on your board (seriously!).

- (a) Parametric area under a curve.
- (b) Polar area under a curve.
- (c) Parametric length of a curve.
- (d) Polar length of a curve.

**Problem 3.** The cardioid is defined by the polar function

$$r = a(1 + \sin \theta).$$

- (a) Plot the cardioid.
- (b) Compute the area of the cardioid.
- (c) Write down parametric cartesian equations for the cardioid.
- (d) Set up the integral for area of the cardioid in cartesian coordinates.
- (e) Set up the integral for length of the cardioid in polar coordinates. To solve, multiply the top and bottom by  $\sqrt{2 - 2 \sin \theta}$ .
- (f) Set up the integral for length of the cardioid in cartesian coordinates.

**Problem 4.**

- (a) Draw the region in  $\mathbb{R}^3$  given by  $x - 2y > 0$ . In symbols:

$$\{\mathbf{x} \in \mathbb{R}^3 : x - 2y > 0\}$$

- (b) Draw the region in  $\mathbb{R}^3$  given by  $1 \leq |\mathbf{x} - 1| \leq 9$ . In symbols:

$$\{\mathbf{x} \in \mathbb{R}^3 : 1 \leq |\mathbf{x}| \leq 9\}$$

- (c) Draw the region in  $\mathbb{R}^3$  given by  $1 \leq |\mathbf{x} - 1| \leq 9$  AND  $x - 2y > 0$ . In symbols:

$$\{\mathbf{x} \in \mathbb{R}^3 : 1 \leq |\mathbf{x}| \leq 9 \text{ and } x - 2y > 0\}$$

**Problem 5.** Textbook 12.2.6.

**Challenge Problem!** Textbook 10.3.77.