1. Describe in words the movements that each of the following functions perform. Which of them are continuous?
   
   (a) \( f(x) = x^2 \)
   
   (b) \( g(x) = |x| \)
   
   (c) \( h(x) = \frac{x}{|x|} \) (let \( h(0) = 0 \))
   
   (d) \( p(x, y) = (x, xy) \)

2. A function \( f : A \to B \) is said to be “surjective” or “onto” if for every point \( b \in B \) there is at least one point in \( A \) that goes to \( b \). A function \( f : A \to B \) is said to be “injective” or “one-to-one” if for every point \( b \in B \) there is at most one point in \( A \) that goes to \( b \).

   (a) Do you think that there exists a surjective continuous function from the torus (surface of a doughnut) to the sphere? If so, describe an example of such a function, in words.
   
   (b) Do you think that there exists a surjective continuous function from the sphere to the torus? If so, describe an example of such a function, in words.
   
   (c) Do you think that there exists an injective continuous function from the sphere to the torus? If so, describe an example of such a function, in words.

3. Find explicit equations for homeomorphisms between the following pairs of sets.

   (a) The closed intervals \((0, 1)\) and \((5, 17)\).
   
   (b) The regions bounded by the ellipses given by
   \[
   \frac{x^2}{4} + \frac{y^2}{9} = 1 \quad \text{and} \quad \frac{(x - 1)^2}{9} + \frac{(y + 3)^2}{16} = 1
   \]
   
   (c) The region inside the unit square, and itself (for this one, find a homeomorphism which is NOT the identity function).
   
   (d) The unit circle, and the square with corners at \((\pm 1, \pm 1)\).

4. Explain why each of the following sets is NOT a compact surface.

   (a) A plane.
   
   (b) The set of points in \( \mathbb{R}^3 \) with \( z = x^2 + y^2 \) and \( z < 1 \).
   
   (c) The set of points in \( \mathbb{R}^3 \) with \( z = x^2 + y^2 \) and \( z \leq 1 \).

5. Draw a triangulation of a torus, and compute the Euler characteristic. Use this computation to explain why the torus and the sphere cannot be homeomorphic.