Exercise 1

1. Find the tangent cone to The set $S$ at $x_0$ where
   
   (a) $S = \{ x^2 + y^2 \leq 1 \}, \quad x^T_0 = [0, 0]$. 
   
   (b) $S = \{ x^2 + y^2 \leq 1 \}, \quad x^T_0 = [0, -1]$. 
   
   (c) $S = \{ x^2 + (y + 1)^2 \leq 2 \} \cap \{ y \geq 0 \}, \quad x^T_0 = [-1, 0]$.

2. Use multiplier conditions to solve

   \[ \min \{ |x| + |y| \} \]

   subject to

   \[ S = \{ ax + by = c, \quad x + y \geq 0 \} \]

   as functions of $a, b, c$.

3. Use Farkas lemma to derive multiplier conditions in the case that the (convex) problem data is differentiable.