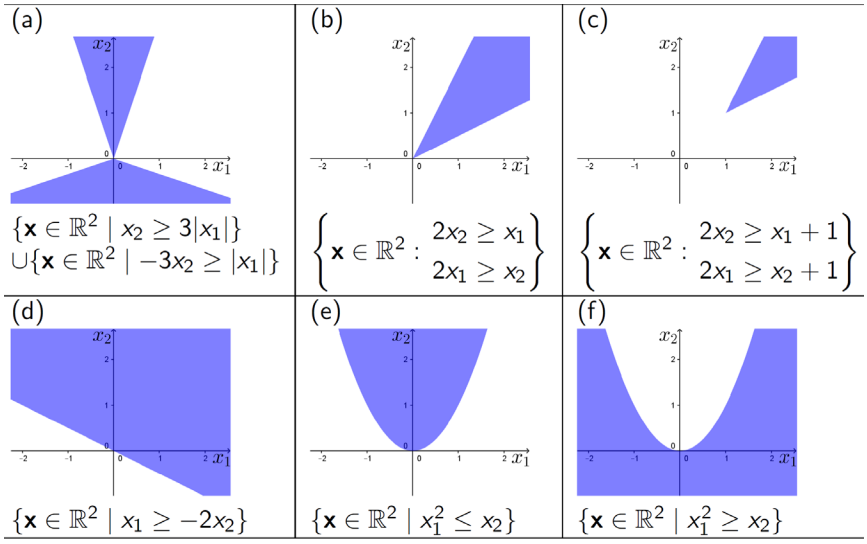
Applied Modeling and Optimization
Exam 1

Closed-book and closed-notes. No Internet allowed. 1 page (2-sided) cheat sheet allowed. Answer all the questions clearly. State your assumptions. Upload the answer on Canvas as a single pdf file. Do not email it to me. Late submissions will not be considered. Canvas will not allow you to upload late submissions.

1. (a) f(x) is a real-valued convex function. Show that the subgraph of f(x) is a convex set. That is, the set $C = \{x \in R: f(x) \leq K\}$ for some constant K is a convex set.
   (b) Suppose f(x) and g(x) are convex functions. Show that a convex combination of f(x) and g(x) is also a convex function.

2. Suppose you are playing an online game with options to connect to WiFi or LTE. The total bandwidth required to play the game is B. The cost of using WiFi bandwidth (x) is 2x and the cost of LTE bandwidth (y) is 3y. Compute the optimal bandwidth usage on both these networks so that the total cost is minimized.

3. Without doing any computations, using simple arguments, state and justify which of the following six sets are cones.




4. Find the maximum area of a rectangle whose perimeter cannot exceed 2.

5. Which of the following functions are convex and why?
   (a) 2log(x)+3
   (b) ax+b
   (c) $x^4+y^4-4xy$