Key Problems

Problem 1.
Check if the given sets are compact (closed and bounded), and if they are convex. It is useful to sketch the sets:

a) $D = \{(x,y) : x,y \geq 0 \text{ and } 2x + 3y \leq 6\}$

b) $D = \{(x,y) : 4x^2 + 9y^2 \leq 36\}$

c) $D = \{(x,y) : x,y \geq 1 \text{ and } 2x + 3y \geq 12\}$

d) $D = \{(x,y) : 4xyz \leq 1 \text{ and } x,y,z > 0\}$

Problem 2.
Determine whether the functions are convex or concave:

a) $f(x,y,z) = x - y + z$

b) $f(x,y,z) = 1 - e^{x-y+z}$

c) $f(x,y,z,w) = (x + y + z + w)^4$

d) $f(x,y) = |x - y|$

Problem 3.
Solve the Lagrange problems. You may assume that all admissible points satisfy the NDCQ:

a) $\max f(x,y,z) = x + 2y + 3z$ when $2x^2 + y^2 + 2z^2 = 9$

b) $\max / \min f(x,y,z) = x^4 + y^4 + z^4$ when $2x^2 + y^2 + 2z^2 = 9$

Problem 4.
Solve the Kuhn-Tucker problems. You may assume that all admissible points satisfy the NDCQ:

a) $\max f(x,y,z) = x - 2y + z$ when $x^2 + y^2 + z^2 \leq 3$

b) $\max f(x,y,z) = \ln(xyz)$ when $2x^2 + y^2 + 2z^2 \leq 6$

Problems from the Workbook

Workbook [W]	7.1 - 7.11 (full solutions in the workbook)
Exam problems	Midterm exam 10/2018 Question 1-8

Answers to Key Problems

Problem 1.

a) Compact and convex set

b) Compact and convex set

c) Convex, but not compact set (not bounded)

d) Not convex and not compact set (not bounded)

Problem 2.

a) Convex and concave

b) Concave

c) Convex

d) Convex

Problem 3.

a) $f_{\max} = 9$

b) $f_{\max} = 81,\ f_{\min} = 9$

Problem 4.

a) $f_{\max} = 3\sqrt{2}$

b) $f_{\max} = \ln(2)/2$