

# Math 233 Warm Up Problems

September 29, 2009

## Solutions

1. Graph the following sets in  $\mathbb{R}^2$ .

- (a)  $\{(x, y) | 1 < x < 3\}$
- (b)  $\{(x, y) | 1 < y < 3\}$
- (c)  $\{(x, y) | 1 < x, y < 3\}$
- (d)  $\{(x, y) | 1 \leq x < 3\}$
- (e)  $\{(x, y) | 1 < y \leq 3\}$
- (f)  $\{(x, y) | 1 \leq x, y \leq 3\}$
- (g)  $\{(x, y) | 1 \leq x \leq y \leq 5\}$

## Lecture Problems

2. Determine if the following sets in  $\mathbb{R}$  are closed, open, neither open nor closed, bounded or unbounded.

- (a)  $(1, 10)$  **Solution:** Open, bounded
- (b)  $[2, 10]$  **Solution:** Closed, bounded
- (c)  $[1, 10)$  **Solution:** Neither open nor closed, bounded
- (d)  $[1, 10] \cup [11, 21]$  **Solution:** Closed, bounded
- (e)  $(1, \infty)$  **Solution:** Open, unbounded
- (f)  $[1, \infty)$  **Solution:** Closed, unbounded
- (g)  $\{1, 2, 3, 4, \dots\}$  **Solution:** Closed, unbounded
- (h)  $(1, 2) \cup (3, 4) \cup (5, 6) \cup \dots$  **Solution:** Open, unbounded

3. Determine if the following sets are closed, open, neither open nor closed, bounded or unbounded.

- (a)  $\{(x, y) | 1 < x < 3\}$  **Solution:** Open, unbounded
- (b)  $\{(x, y) | 1 < y < 3\}$  **Solution:** Open, unbounded
- (c)  $\{(x, y) | 1 < x, y < 3\}$  **Solution:** Open, bounded
- (d)  $\{(x, y) | 1 \leq x < 3\}$  **Solution:** Neither open nor closed, unbounded
- (e)  $\{(x, y) | 1 < y \leq 3\}$  **Solution:** Neither open nor closed, unbounded
- (f)  $\{(x, y) | 1 \leq x, y \leq 3\}$  **Solution:** Closed, bounded
- (g)  $\{(x, y) | 1 \leq x \leq y \leq 5\}$  **Solution:** Closed, bounded

4. Find the absolute maximum and absolute minimum of the function  $f(x, y) = 2x^2 - 3xy + 6x$  on the rectangle  $\{(x, y) | -1 \leq x \leq 2, -1 \leq y \leq 4\}$ .

(a) Find all critical points inside the rectangle.

**Solution:**  $\nabla f = (4x - 3y + 6, 3x)$  and the only critical point is at  $(0, 2)$ .

(b) Find the max/min of the function for  $x = -1, -1 \leq y \leq 4$ .

**Solution:** Max of 8 at  $(-1, 4)$ . Min of  $-7$  at  $(-1, -1)$ .

(c) Find the max/min of the function for  $x = 2, -1 \leq y \leq 4$ .

**Solution:** Max of 26 at  $(2, -1)$ . Min of  $-4$  at  $(2, 4)$ .

(d) Find the max/min of the function for  $y = -1, -1 \leq x \leq 2$ .

**Solution:** Max of 26 at  $(2, -1)$ . Min of  $-7$  at  $(-1, -1)$ .

(You should have also found a point outside the range:  $(-9/4, -1)$ ).

(e) Find the max/min of the function for  $y = 4, -1 \leq x \leq 2$ .

**Solution:** Max of 8 at  $(-1, 4)$ . Min of  $-9/2$  at  $(3/2, 4)$ .

(f) What is the global max and min on the closed rectangle?

**Solution:** Max of 26. Min of  $-7$ .