## Homework 21 : Due Monday, November 9

**Problem 1:** Chapter 12, #2ab

**Problem 2:** Chapter 12, #3

**Problem 3:** Chapter 12, #5ab
*Hint:* Use a bit of theory to help with the computations. You know the orbits partition $X$, and you know that the size of any orbit divides $|G|$. Once you know $\mathcal{O}_x$, you can use the Orbit-Stabilizer Theorem to determine $|G_x|$.

**Problem 4:** Let $G = \mathbb{R}$ (under addition) and let $X = \mathbb{R}^2$. Define a function from $G \times X$ to $X$ by $a * (x, y) = (x + ay, y)$.
a. Show that $*$ is a action of $G$ on $X$.
b. Describe the orbits of the action geometrically.

**Problem 5:** Let $G = S_3$ and let

$$X = \{1, 2, 3\} \times \{1, 2, 3\} = \{(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)\}$$

Define a function from $G \times X$ to $X$ by $\sigma * (x, y) = (\sigma(x), \sigma(y))$.
a. Show that $*$ is a action of $G$ on $X$.
b. Find the orbits of the action.