Exercise Set 1.2

1. Which of the following sets are equal?

$A = \{a, b, c, d\}$ $\quad B = \{d, e, a, c\}$
$C = \{d, b, a, c\}$ $\quad D = \{a, a, d, e, c, e\}$

2. Write in words how to read each of the following out loud.
   a. $\{x \in \mathbf{R}^+ \mid 0 < x < 1\}$
   b. $\{x \in \mathbf{R} \mid x \leq 0 \text{ or } x \geq 1\}$
   c. $\{n \in \mathbf{Z} \mid n \text{ is a factor of } 6\}$
   d. $\{n \in \mathbf{Z}^+ \mid n \text{ is a factor of } 6\}$

3. a. Is $4 = \{4\}$?
   b. How many elements are in the set $\{3, 4, 3, 5\}$?
   c. How many elements are in the set $\{1, \{1\}, \{1, \{1\}\}\}$?

4. a. Is $2 \in \{2\}$?
   b. How many elements are in the set $\{2, 2, 2, 2\}$?
   c. How many elements are in the set $\{0, \{0\}\}$?
   d. Is $\{0\} \in \{\{0\}, \{1\}\}$?
   e. Is $0 \in \{\{0\}, \{1\}\}$?

***H* 5.** Which of the following sets are equal?

$$A = \{0, 1, 2\}$$
$$B = \{x \in \mathbf{R} \mid -1 \leq x < 3\}$$
$$C = \{x \in \mathbf{R} \mid -1 < x < 3\}$$
$$D = \{x \in \mathbf{Z} \mid -1 < x < 3\}$$
$$E = \{x \in \mathbf{Z}^+ \mid -1 < x < 3\}$$

***H* 6.** For each integer n, let $T_n = \{n, n^2\}$. How many elements are in each of T_2, T_{-3}, T_1 and T_0? Justify your answers.

7. Use the set-roster notation to indicate the elements in each of the following sets.
   a. $S = \{n \in \mathbf{Z} \mid n = (-1)^k, \text{ for some integer } k\}$.
   b. $T = \{m \in \mathbf{Z} \mid m = 1 + (-1)^i, \text{ for some integer } i\}$.
   c. $U = \{r \in \mathbf{Z} \mid 2 \leq r \leq -2\}$
   d. $V = \{s \in \mathbf{Z} \mid s > 2 \text{ or } s < 3\}$
   e. $W = \{t \in \mathbf{Z} \mid 1 < t < -3\}$
   f. $X = \{u \in \mathbf{Z} \mid u \leq 4 \text{ or } u \geq 1\}$

8. Let $A = \{c, d, f, g\}$, $B = \{f, j\}$, and $C = \{d, g\}$. Answer each of the following questions. Give reasons for your answers.
   a. Is $B \subseteq A$? b. Is $C \subseteq A$?
   b. Is $C \subseteq C$? d. Is C a proper subset of A?

9. **a.** Is $3 \in \{1, 2, 3\}$? **b.** Is $1 \subseteq \{1\}$?
   c. Is $\{2\} \in \{1, 2\}$? d. Is $\{3\} \in \{1, \{2\}, \{3\}\}$?
   e. Is $1 \in \{1\}$? f. Is $\{2\} \subseteq \{1, \{2\}, \{3\}\}$?
   g. Is $\{1\} \subseteq \{1, 2\}$? h. Is $1 \in \{\{1\}, 2\}$?
   i. Is $\{1\} \subseteq \{1, \{2\}\}$? j. Is $\{1\} \subseteq \{1\}$?

10. **a.** Is $((-2)^2, -2^2) = (-2^2, (-2)^2)$?
    b. Is $(5, -5) = (-5, 5)$?
    c. Is $(8 - 9, \sqrt[3]{-1}) = (-1, -1)$?
    d. Is $\left(\frac{-2}{-4}, (-2)^3\right) = \left(\frac{3}{6}, -8\right)$?

11. Let $A = \{w, x, y, z\}$ and $B = \{a, b\}$. Use the set-roster notation to write each of the following sets, and indicate the number of elements that are in each set:
   a. $A \times B$ b. $B \times A$
   c. $A \times A$ d. $B \times B$

12. Let $S = \{2, 4, 6\}$ and $T = \{1, 3, 5\}$. Use the set-roster notation to write each of the following sets, and indicate the number of elements that are in each set:
   a. $S \times T$ b. $T \times S$
   c. $S \times S$ d. $T \times T$