Solutions

1.1.1. Determine whether each of the following is true / false (ODEV-1)

a) $\emptyset \subseteq \emptyset$
Yes it is true. The null set (empty set) is a subset of all sets.

b) $\emptyset \epsilon \emptyset$
False. An empty set is a set with no elements.

c) $\emptyset \epsilon \{\emptyset\}$
Yes. $\emptyset$ is empty set with cardinality 0. However, $\{\emptyset\}$ is a set with one element $\emptyset$.

d) $\emptyset \subseteq \{\emptyset\}$
Yes. The null set (empty set) is a subset of all sets.

e) $\{a, b\} \epsilon \{a, b, c, \{a, b\}\}$
Yes. As { {a,b} } is an element of $\{a, b, c, \{a, b\}\}$.

f) $\{a, b\} \subseteq \{a, b, \{a, b\}\}$
Yes. As {a,b} is an element of $\{a, b, c, \{a, b\}\}$

g) $\{a, b\} \subseteq$ ***Power set of*** $\{a, b, \{a, b\}\}$
Yes.

h) $\{\{a, b\}\} \epsilon$ ***Power set of*** $\{a, b, \{a, b\}\}$
Yes.

i) $\{a, b, \{a, b\}\} - \{a, b\} = \{a, b\}$
False. It must be { {a,b} }

1. 1.2.

(a) {3, 5}
(b) {3, 5, 7}
(c) {1, 2, 7, 9}
(d) {8}, {7, 8}, {8, 9}, {7, 8, 9}
(e) {∅}
(f) {0, 1, 4, 9, 25, 36…} (the perfect squares)
(g) ∅ (since the square root of 2 is not an integer)

1.1.3.

(a)

$A \cup (B \cap C)$	$= (B \cap C) \cup A$	commutativity
	$= (B \cup A) \cap (C \cup A)$	distributivity
	$= (A \cup B) \cap (A \cup C)$	commutativity

(b)

$A \cap (B \cup C)$	$= (B \cup C) \cap A$	commutativity
	$= (B \cap A) \cup (C \cap A)$	distributivity
	$= (A \cap B) \cup (A \cap C)$	commutativity

(c) $A \cap (A \cup B) = (A \cup B) \cap A$ commutativity
$= A$ absorption

1.1.4. (a) {(1,1,1), (1,1,2), (1,1,3), (1,2,1), (1,2,2),, (1,2,3)}
(b) ∅
(c) {(∅,1), (∅,2), ({1}, 1), ({1}, 2), ({2}, 1), ({2}, 2), ({1,2}, 1), ({1,2}, 2)}

1.3.1. Drawing

1.3.2.
a) R is not reflexive, is not symmetric, is not transitive
S is not reflexive, is symmetric, is not transitive

b) RUS is reflexive, is not symmetric, is not transitive

1.3.3. Drawing

1.3.4. Let A be a non-empty set and Let R is a subset of AxA be the empty set. Which properties does R have.
Let us assume any set and any relation R for that set.
Let set A = {1, 2, 3, 4} and the relation for set A will be R = {(a, b): a + b = 10}
So, we observe that a + b ≠ 10 for any two elements of set A.
Therefore (a, b) ∉ R for any a, b∈ A.
R does not contain elements of A×A. So, R will be the empty set.
And, R will be the empty relation on set A. So, empty relation is not reflexive because it does not contain (a, a) for any a∈R.
As we know the definition of symmetric relation that if A be a set in which the relation R is defined. Then R is said to be a symmetric relation, if (a, b) ∈ R⇒ (b, a)∈ R.
Now for empty relation R does not contain any element of set A. So, relation R will be trivially symmetric.
As we know the definition of transitive relation that a relation R over a set A is transitive if for all elements a, b, c in A. Whenever R relates a to b and b to c, then R also relates a to c.
So, a empty relation has no element. So, it will also be trivially transitive.
So, empty relation is not reflexive but is symmetric and transitive.