

## Unit 3

### Algebraic Structures

#### Choose the Correct Answer

##### 1. What is an algebraic system?

- A) A set without operations
- B) A set together with one or more operations
- C) Only a collection of numbers
- D) A set of equations

**Answer: B) A set together with one or more operations**

##### 2. Which property means $a * b$ belongs to the same set?

- A) Associativity
- B) Commutativity
- C) Closure
- D) Identity

**Answer: C) Closure**

##### 3. Which of the following is the associative property?

- A)  $a * b = b * a$
- B)  $(a * b) * c = a * (b * c)$
- C)  $a * e = a$
- D)  $a * a = a$

**Answer: B)  $(a * b) * c = a * (b * c)$**

##### 4. A semigroup must satisfy:

- A) Closure and associativity
- B) Commutativity only
- C) Identity only
- D) Inverses only

**Answer: A) Closure and associativity**

##### 5. A monoid is a semigroup having:

- A) An inverse element
- B) A zero element only
- C) An identity element
- D) A commutative operation

**Answer: C) An identity element**

**6. Which of the following is an example of a monoid?**

- A) Positive integers under addition
- B) Integers under subtraction
- C) Natural numbers under subtraction
- D) Real numbers under division

**Answer: A) Positive integers under addition**

**7. The identity element for addition is:**

- A) 1
- B) -1
- C) 0
- D)  $\infty$

**Answer: C) 0**

**8. The identity element for multiplication is:**

- A) 0
- B) 1
- C) -1
- D) 2

**Answer: B) 1**

**9. A partially ordered set is commonly abbreviated as:**

- A) Set
- B) Group
- C) Poset
- D) Semigroup

**Answer: C) Poset**

**10. Which three properties define a partial order?**

- A) Closure, identity, inverse
- B) Reflexive, symmetric, transitive
- C) Reflexive, antisymmetric, transitive
- D) Symmetric, antisymmetric, closure

**Answer: C) Reflexive, antisymmetric, transitive**

**11. In a lattice, the greatest lower bound is called:**

- A) Join
- B) Meet

- C) Maximum
- D) Union

**Answer: B) Meet**

**12. In a lattice, the least upper bound is called:**

- A) Meet
- B) Intersection
- C) Join
- D) Minimum

**Answer: C) Join**

**13. Boolean algebra is primarily based on:**

- A) 0 and 1
- B) 1 and 2
- C) Positive and negative numbers
- D) Real numbers

**Answer: A) 0 and 1**

**14. Which is a Boolean algebra complement law?**

- A)  $a + a = a$
- B)  $a \cdot 1 = a$
- C)  $a + a' = 1$
- D)  $a + 0 = 0$

**Answer: C)  $a + a' = 1$**

**15. Which Boolean expression represents the AND operation?**

- A)  $a + b$
- B)  $a \cdot b$
- C)  $a - b$
- D)  $a/b$

**Answer: B)  $a \cdot b$**

Fill in the Blanks

1. An algebraic system consists of a non-empty set together with one or more \_\_\_\_\_ defined on it.
2. A binary operation on a set  $S$  combines two elements of  $S$  to produce an element of \_\_\_\_\_.

3. A set closed under a binary operation and satisfying associativity is called a \_\_\_\_\_.
4. A semigroup with an identity element is called a \_\_\_\_\_.
5. The identity element  $e$  satisfies  $a * e = e * a =$ \_\_\_\_\_.
6. A binary operation  $*$  is associative if  $(a * b) * c =$ \_\_\_\_\_.
7. A set with a binary operation that is closed and associative forms a \_\_\_\_\_.
8. A partially ordered set is also called a \_\_\_\_\_.
9. In a poset, the relation must be reflexive, antisymmetric, and \_\_\_\_\_.
10. A lattice is a poset in which every pair of elements has a greatest lower bound and a \_\_\_\_\_.
11. The greatest lower bound of two elements is called their \_\_\_\_\_.
12. The least upper bound of two elements is called their \_\_\_\_\_.
13. Boolean algebra deals with elements that generally take values \_\_\_\_\_ and 1.
14. In Boolean algebra,  $a + 0 =$ \_\_\_\_\_.
15. In Boolean algebra,  $a \cdot 1 =$ \_\_\_\_\_.

### Answers

1. Operations
2.  $S$
3. Semigroup
4. Monoid
5.  $a$
6.  $a * (b * c)$
7. Semigroup
8. Poset
9. Transitive
10. Least upper bound
11. Meet
12. Join
13. 0

14. *a*

15. *a*