1. A **set with one operation** is called a:
   a) Group
   b) Monoid
   c) Semigroup
   d) Algebraic structure

2. A **binary operation** on a set is a function that:
   a) Maps one element to another
   b) Combines two elements to produce a third element in the set
   c) Maps a set to an external element
   d) Only works for finite sets

3. Which of the following properties is NOT necessary for a set with one operation to be a **semigroup**?
   a) Closure
   b) Associativity
   c) Commutativity
   d) At least one binary operation

4. A **set with one operation** must always satisfy which of the following properties?
   a) Closure
   b) Inverse
   c) Commutativity
   d) Identity

5. A **semigroup** is a set equipped with a binary operation that is:
   a) Associative
   b) Commutative
   c) Invertible
   d) Distributive

6. A **monoid** is a semigroup that also has:
   a) An inverse for every element
   b) A unique identity element
   c) Commutativity
   d) No closure property

7. If a semigroup contains an **identity element**, it is called a:
   a) Monoid
   b) Group
   c) Field
   d) Lattice

8. If every element in a monoid has an inverse, the structure becomes a:
   a) Semigroup
   b) Monoid
   c) Group
   d) Ring

9. A **commutative semigroup** is called:
   a) Abelian semigroup
   b) Monoid
   c) Ring
   d) Group

10. Which of the following is an example of a **binary operation**?
    a) Addition of real numbers
    b) Taking the square root of a number
    c) Finding the absolute value of a number
    d) Mapping an integer to its opposite

11. The **identity element** of multiplication in real numbers is:
    a) 0
    b) 1
    c) -1
    d) 2

12. A binary operation * is said to be **associative** if:
    a) $(a*b)*c=a*(b*c)$ for all a,b,c in the set
    b) $a*b=b*a$ for all a,b in the set
    c) $a*e=a$ for all a in the set
    d) Every element has an inverse

13. Which of the following binary operations is NOT **associative**?
    a) Addition of integers
    b) Multiplication of real numbers
    c) Subtraction of integers
    d) Function composition

14. In **modular arithmetic**, what is 7+5 mod 4?
    a) 0
    b) 1
    c) 2
    d) 3

15. Which of the following **modular arithmetic properties** is always true for any modulus mmm?
    a) $(a+b) \bmod m = (a \bmod m+b \bmod m) \bmod m$
    b) $(a-b) \bmod m = (a \bmod m-b \bmod m) \bmod m$
    c) $(a\times b) \bmod m = (a \bmod m\times b \bmod m) \bmod m$
    d) All of the above

16. A **Galois field** GF(p) is a field with:
    a) An infinite number of elements
    b) A finite number of elements
    c) No inverse elements
    d) No closure property

17. The number of elements in a **Galois field GF(p^n)** is:
    a) p
    b) p^n
    c) n^p
    d) p+n

18. In **modular arithmetic**, the multiplicative inverse of **3 modulo 7** is:
    a) 2
    b) 3
    c) 5
    d) 6

19. The **basis vectors** of a graph are associated with:
    a) The fundamental cycles of the graph
    b) The adjacency matrix of the graph
    c) The spanning tree of the graph
    d) The number of isolated vertices in the graph

20. If a **graph has n vertices and mmm edges**, the number of basis vectors in the cycle space is:
    a) m−n+1
    b) m+n−1
    c) n−m+1
    d) m−2n+1