--Question Starting--
Match the following algebraic structures with their defining properties:
1. Groups 2. Rings 3. Fields
A. Every non-zero element has a multiplicative inverse
B. Closure, associativity, identity, and inverses under a single operation
C. Addition and multiplication are both commutative
D. Closure, associativity, distributivity over addition, with additive identity and additive inverses
Choose the correct answer from the options given below:
(1) 1-B, 2-D, 3-A
(2) 1-B, 2-D, 3-C
(3) 1-A, 2-D, 3-C
(4) 1-B, 2-C, 3-A
Answer Key: 3
Solution:
? Groups: An algebraic structure with a single operation, where closure, associativity, identity, and inverses exist. The key property is every element having an inverse, aligning with option B.
? Rings: Consist of two operations (addition and multiplication) with closure, associativity, distributivity, and additive identity/inverses, matching option D.
? Fields: Are rings with multiplicative inverses for all non-zero elements and commutative multiplication, satisfying properties of addition and multiplication being commutative, aligning with option C.
Hence, Option (3) is the right answer.

--Question Starting--
Match the following graph theoretical concepts with their properties:
1. Eulerian Path 2. Hamiltonian Path 3. Spanning Tree
A. Visits every vertex exactly once
B. Visits every edge exactly once, possibly starting and ending at different vertices
C. Connects all vertices with the minimum number of edges
D. Includes all vertices and some subset of edges forming a tree
Choose the correct answer from the options given below:
(1) 1-B, 2-A, 3-D
(2) 1-A, 2-B, 3-C
(3) 1-B, 2-C, 3-D
(4) 1-A, 2-C, 3-D
Answer Key: 2
Solution:
? Eulerian Path: Traverses every edge exactly once, which is characteristic of option B.
? Hamiltonian Path: Visits each vertex exactly once, matching option A.
? Spanning Tree: Connects all vertices with the minimum number of edges without forming cycles, which is captured by option C and D; typically, the spanning tree is a subset of edges forming a tree covering all vertices, hence option D.
Given the options, the matching with the properties indicates Option (2).
Hence, the correct answer is (2).

--Question Starting--
Match the following topics with their advanced characteristics:
1. Isomorphism in Group Theory 2. Homomorphism in Algebra 3. Graph Coloring
A. Assigns colors to vertices such that no adjacent vertices share the same color
B. A structure-preserving map between two algebraic structures
C. Two groups are structurally identical if there exists a bijective homomorphism between them
D. Maps between algebraic structures that may not be bijective but preserve the operation
Choose the correct answer from the options given below:
(1) 1-C, 2-D, 3-A

(2) 1-D, 2-B, 3-C
(3) 1-C, 2-B, 3-A
(4) 1-B, 2-D, 3-C
Answer Key: 3
Solution:
? Isomorphism in Group Theory: It indicates a structural identity between two groups via a bijective homomorphism, aligning with option C.
? Homomorphism in Algebra: A map that preserves structure but may not be bijective, matching option D.
? Graph Coloring: Assigns colors to vertices to prevent adjacent vertices from sharing the same color, fitting option A.
Thus, the correct associations are given in option (3).
Hence, the correct answer is (3).