CC4 Mathematics
Unit-wise MCQ

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Unit 1

1. Binary operation on a set A is a mapping whose domain set is
   - (a) $\mathbb{R}$
   - (b) A
   - (c) $A \times A$
   - (d) none of these
2. Arithmetical subtraction(-) is binary relation on
   - (a) $\mathbb{Z}$
   - (b) $\mathbb{Z}^+$
   - (c) $\mathbb{Z}^-$
   - (d) $\mathbb{Q}$
3. Which of the following is not associative operation?
   - (a) arithmetic addition
   - (b) matrix addition
   - (c) arithmetic subtraction
   - (d) matrix multiplication
4. Consider the group $\mathbb{Z}^2 = \{(a,b) : a,b \in \mathbb{Z}\}$ under component-wise addition.Then which of the following is a subgroup of $\mathbb{Z}^2$?
   - (a) $\{(a,b) \in \mathbb{Z}^2 \mid ab = 0\}$
   - (b) $\{(a,b) \in \mathbb{Z}^2 | 3a + 2b = 15\}$
   - (c) $\{(a,b) \in \mathbb{Z}^2 |\ 7|ab\}$
   - (d) $\{(a,b) \in \mathbb{Z}^2 |\ 2|a \text{ and } 3|b\}$
5. In the group $GL(2, \mathbb{Z}_7)$, inverse of $A = \begin{pmatrix} 4 & 5 \\ 6 & 3 \end{pmatrix}$ is
   - (a) $\begin{pmatrix} 1 & 2 \\ 5 & 3 \end{pmatrix}$
   - (b) $\begin{pmatrix} 1 & 3 \\ 5 & 6 \end{pmatrix}$
   - (c) $\begin{pmatrix} 5 & 6 \\ 3 & 1 \end{pmatrix}$

(d) none of these

6. In $\mathbb{C}^* = \mathbb{C} \setminus \{0\}$ denote the group of non-zero complex numbers under multiplication. Suppose $Y_n = \{z \in \mathbb{C} \mid z^n = 1\}$, $n \in \mathbb{N}$. Which of the following is not a subgroup of $\mathbb{C}^*$?

   (a) $\bigcup_{n=1}^{100} Y_n$
   (b) $\bigcup_{n=1}^{\infty} Y_{2^n}$
   (c) $\bigcup_{n=100}^{\infty} Y_n$
   (d) $\bigcup_{n=1}^{\infty} Y_n$

7. Which of the following groupoid is a group?

   (a) $(\mathbb{N}, \circ),\ a \circ b = a + b\ \forall a, b \in \mathbb{N}$
   (b) $(\mathbb{N}, \circ),\ a \circ b = a\ \forall a, b \in \mathbb{N}$
   (c) $(\mathbb{Z}, \circ),\ a \circ b = a + b - 1\ \forall a, b \in \mathbb{Z}$
   (d) $(\mathbb{Z}, \circ),\ a \circ b = a + 2b\ \forall a, b \in \mathbb{Z}$

Unit 2

1. If G be a cyclic group of order 8 with generator x then another generator of G be:

   (a) x^5
   (b) x^4
   (c) x^6
   (d) x^2

2. If the cyclic group G contains 11 distinct elements then it has:

   (a) only one generator
   (b) two generators
   (c) three generators
   (d) ten generators

3. The set of all even integers $2\mathbb{Z}$ is a subgroup of $(\mathbb{Z}, +)$ Then the right coset $2\mathbb{Z}$+(-3) contains the element

   (a) 4
   (b) 6
   (c) 1
   (d) 10

4. If the group G contains 13 distinct elements then the number of possible subgroup($\neq G$) of G is

   (a) 10
   (b) 12
   (c) 5
   (d) 1

5. A group containing 27 elements is necessarily abelian:

   (a) True
   (b) False

6. Let H be a subgroup of a group G and $a, b \in G$. Then $b \in aH$ if and only if :
   (a) $ab \in H$
   (b) $ab^{-1} \in H$
   (c) $a^{-1}b \in H$
   (d) none of these

7. Let A_6 be the group of even permutations of 6 distinct symbols. Then the number of elements of order 6 in A_6 is:
   (a) 0
   (b) 1
   (c) 3
   (d) 6

8. In the permutation group $S_n(n \geq 5)$,if H is the smallest subgroup containing all the 3-cycles,then which one of the following is true?
   (a) Order of H is 2
   (b) Index of H in S_n is 2 https://www.overleaf.com/project/5e44af69cce67a00011c5054
   (c) H is abelian
   (d) $H = S_n$

9. Which one of the following is true?
   (a) Z_n is cyclic if and only if n is prime.
   (b) Every proper subgroup of Z_n is cyclic.
   (c) Every proper subgroup of S_4 is cyclic.
   (d) If every proper subgroup of a group is cyclic , then the group is cyclic.

10. Let f, g, h are the permutations on the set $\{\alpha, \beta, \gamma, \delta\}$,where
    f interchanges α *and* β but *fixes* γ *and* δ
    g interchanges β *and* γ but *fixes* α *and* δ
    h interchanges γ *and* δ but *fixes* α *and* β
    Which of the following permutations interchange(s) α *and* δ but *fixes* β *and* γ ?
    (a) $f \circ g \circ h \circ g \circ f$
    (b) $g \circ h \circ f \circ h \circ g$
    (c) $g \circ f \circ h \circ f \circ g$
    (d) $h \circ g \circ f \circ g \circ h$

11. Let G be a group. Let $x \in G$ be such that $O(x) = 5$. Then:
    (a) $O(x^{10}) = 5$
    (b) $O(x^{15}) = 5$
    (c) $O(x^{23}) = 5$
    (d) none of these

12. In the additive group $\mathbb{Z}_6$ the order of the element [4] is :
    (a) 0
    (b) 2

(c) 3
(d) 6

13. Let G be a group. Let $x, y \in G$ be such that $O(x) = 4, O(y) = 2,\ x^3y = yx$,Then $O(xy)$ is :.

(a) 2
(b) 5
(c) 6
(d) ∞

14. The number of elements of order 2 in a finite group of even order is:

(a) a prime number
(b) an even number
(c) an odd number
(d) exactly one

15. If $p = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 3 & 6 & 5 & 4 & 1 \end{pmatrix}$, which of the following is true?

(a) $p^2 = i$
(b) $p^3 = i$
(c) $p^4 = i$
(d) $p^5 = i$

16. Let H, K be two subgroups of a group G such that $O(H) = 5, O(K) = 9$.Then $O(HK)$ is :

(a) 1
(b) 5
(c) 9
(d) 45

Unit 3

1. The total number of normal subgroups of the Klein's 4 group is :

(a) 1
(b) 3
(c) 4
(d) 5

2. Let G be f order 20 a group o

(a) normal
(b) not normal
(c) isomorphic to G
(d) none of the above

3. The number of normal subgroups of order 7 in a group of order 14 is :

(a) 1
(b) 3

(c) 5

(d) 7

4. Let $G = (\mathbb{C}^*, \cdot)$ be the group of non-zero complex numbers. Let $H = \{z \ \in G : |z| = 1\}$.Then G/H is isomorphic to:

(a) $\mathbb{Q}^*$

(b) $\mathbb{R}^+$

(c) $\mathbb{Z}^*$

(d) none of these

5. The centre $\mathbb{Z})G)$ of a group G is :

(a) a cyclic subgroup of G

(b) a non-cyclic subgroup of G

(c) a normal subgroup of G

(d) not a normal subgroup of G

6. The number of subgroups of the group $\mathbb{Z}/42\mathbb{Z}$

(a) 6

(b) 7

(c) 8

(d) 2

7. Let G be a group of order 231. The number of elements of order 11 in G is :

(a) 10

(b) 1

(c) 11

(d) 15

8. Let $(G, \circ)$ and $(G', \star)$ be two groups and $\phi : G \to G'$ be a homomorphism.Then ϕ is one-one if and only if :

(a) $\ker \phi = \{e_{G'}\}$

(b) $\ker \phi = \{e_G\}$

(c) $\ker \phi = G$

(d) $\ker \phi \subset G'$

9. Let $\phi : (\mathbb{R}, +) \ \to (\mathbb{R} - \{0\}, \cdot)$ is a homomorphism and $\phi(2) = 3$,then $\phi(-6)$ is:

(a) 1/3

(b) 1/9

(c) 1/27

(d) -18

10. The number of homomorphism from $\mathbb{Z}_4$ to $\mathbb{Z}_{12}$ is:

(a) 4

(b) 3

(c) 12
(d) 48

11. The number of onto homomorphism from $\mathbb{Z}_8$ to $\mathbb{Z}_4$ is:
    (a) 4
    (b) 3
    (c) 2
    (d) 1

12. The number of group homomorphism from the cyclic group $\mathbb{Z}_4$ to the cyclic group $\mathbb{Z}_7$ is:
    (a) 7
    (b) 3
    (c) 2
    (d) 1

13. Let G be a group of order 48 and H be a subgroup of order 24.Then :
    (a) H is normal
    (b) H is commutative
    (c) H is not normal
    (d) none of these

14. Let G be a group satisfying the property that $f : G \to \mathbb{Z}_{221}$ is a homomorphism implies$f(g) = 0\ \forall g \in G$ .Then a possible group G is :
    (a) $\mathbb{Z}_{21}$
    (b) $\mathbb{Z}_{51}$
    (c) $\mathbb{Z}_{91}$
    (d) $\mathbb{Z}_{119}$

15. Let H denotes the quotient group $\mathbb{Q}/\mathbb{Z}$,Consider the following statements:
    I.Every cyclic group of H is finite.
    II.Every finite cyclic group is isomorphic to a subgroup of H.
    Which of the following holds:
    (a) I is true but II is false
    (b) II is true but I is false
    (c) Both I and II are true
    (d) Neither I nor II is true.

16. Which of the following is isomorphism?
    (a) $f : (\mathbb{Z},\ +) \to (\mathbb{Q},\ +)$
    (b) $f : (\mathbb{Q},\ +) \to (\mathbb{R},\ +)$
    (c) $f : (\mathbb{Q},\ +) \to (\mathbb{Q},\ \cdot)$
    (d) none of these

17. Let $(G, \circ)$ and $(G', \star)$ be two groups and $\phi : G \to G'$ be an isomorphism. Then :
    (a) G' is commutative if and only if G is cyclic.

(b) G' is commutative if G is commutative.

(c) G' might not be commutative even if G is commutative.

(d) G' might be commutative even if G is commutative

18. Let G be a finite group and H be a normal subgroup of G of order 2. Then the order of the center of G is:

    (a) 0

    (b) 1

    (c) an integer ≥ 2

    (d) an odd integer ≥ 3

19. Let G be a cyclic group of order 24. The total number of group homomorphism of G onto itself is:

    (a) 7

    (b) 8

    (c) 17

    (d) 24