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By Muhammad Tahir Aziz Takleed

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$$a^2 + b^2 = c^2$$

Eden MATHEMATICS

Original Past Papers of
PPSC, FPSC, SPSC, AJKPSC, KPPSC
with Solution

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GAT Test**

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Title

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By

Muhammad Tahir Aziz Takleed

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Lecturer Math Past Paper PPSC 2011

Q.1 A ring R is called boolean Ring if, for all $x \in R$

(A) $x^2 = x$ (B) $x^2 = -x$

(C) $x^2 = 0$ (D) $x^2 = 1$

Solution:

Definition: A ring R with identity is called a Boolean if $x^2 = x, \forall x \in R$

Definition: A ring in which $x^2 = 0$ is called nilpotent ring

Theorem: Every Boolean ring is commutative ring

Q.2 The group of Quaternion is a non-Abelian group of order _____.

(A) 6 (B) 8

(C) 10 (D) 4

Solution:

Group of Quaternion

$$Q_8 = \{\pm 1, \pm i, \pm j, \pm k\}$$

With $(-1)^2 = 1, (i)^2 = -1,$

$(j)^2 = -1, (k)^2 = -1,$

$ij = k, jk = i, ki = j, ji = -k,$

$kj = -i, ik = -j$

The order of Quaternion is 8.

D_4 is other non-Abelian group of order 8

Q.3 Every group of prime order is _____.

(A) An Abelian but not cyclic

(B) An Abelian

(C) A non Abelian group

(D) A cyclic group

Solution:

Theorem: Every group of prime order is cyclic.

Theorem: Every cyclic group is Abelian but converse is not true.

Theorem: A simple Abelian group \Leftrightarrow the order is a prime number.

Q.4 Any two conjugate subgroups of a group are _____.

(A) Equivalent (B) Similar

(C) Isomorphic (D) None of these

Solution:

Definition: Let G be a group. K and H be a subgroup of G , K and H are said conjugate subsets if there $\exists g \in G$ s.t $K = gHg^{-1}$

The mapping defined as $\varphi(h) = ghg^{-1}$

- If g and g' are conjugate in G , Then they have same order

- If H and H' are conjugate subgroup of G , then they have same order

- If H and H' are conjugate subgroup of G , then they are isomorphic groups.

Q. 5 If H is a subgroup of index _____, then H is a normal subgroup of G .

(A) 2 (B) 4

(C) Prime number (D) None of these

Solution:

Index of Group: Let H be a subgroup of G . Then $[G:H]$ = number of distinct left or right cosets of H in G .

Theorem: Any subgroup of index 2 is a normal subgroup

Q.6 $n\mathbb{Z}$ is a maximal ideal of a ring \mathbb{Z} if and only if n is _____.

- (A) Prime Number
- (B) Composite Number
- (C) Natural Number
- (D) None of these

Solution:

- The proper (Maximal) ideal of \mathbb{Z} exactly $p\mathbb{Z}$ where p is prime
- By canonical corresponding $\mathbb{Z} \rightarrow \frac{\mathbb{Z}}{n\mathbb{Z}}$, the maximal ideals of $\frac{\mathbb{Z}}{n\mathbb{Z}}$ corresponding exactly to the maximal ideals of \mathbb{Z} that contain $n\mathbb{Z}$.
- The positive divisor of 17 are 1 and 17

$$\langle 1 \rangle = \mathbb{Z}_{17}$$

$$\langle 17 \rangle = \{0\}$$

- $\langle 1 \rangle$ and $\langle 17 \rangle$ are improper ideals there is no prime divisor so there is no proper ideals of \mathbb{Z}_{17}

- Let \mathbb{Z}_8 the positive divisor of 8 are 1, 2, 4, 8. The ideals in \mathbb{Z}_8 are

$$(1) = \mathbb{Z}_8$$

$$(2) = \{0, 2, 4, 6\}$$

$$(4) = \{0, 4\}$$

$$(8) = \{0\}$$

From above (2) is maximal (2 is prime), (1) and (8) are improper so, neither prime nor maximal. $(4) \subseteq (2)$ so 4 not is maximal.

Q.7 Let G be a cyclic group of order 24 generated by a then order of a^{10}

- (A) 2
- (B) 12
- (C) 10
- (D) None of these

Solution:

$$O(G) = 24$$

$$\text{Let } O(a^{10}) = m$$

$$\text{Then } (a^{10})^m = e \Rightarrow O(a) = 10m$$

As we know order of element divide the order of group

$$\text{So } 24 \mid 10m$$

$$\Rightarrow 10m = 24k \quad k \in \mathbb{Z}$$

$$m = \frac{24}{2} = 12$$

Other method

$$|a^k| = \frac{|G|}{\gcd(|G|, k)}$$

$$\gcd(|G|, k) = \gcd(24, 10) = 2$$

$$|a^k| = \frac{24}{2} = 12$$

$$m = \frac{24}{10} k$$

$$m = \frac{12}{5} k$$

For least positive number

$$k = 5 \Rightarrow m = 12$$

$$O(a^{10}) = m = 12$$

Q.8 If a vector space V has a basis of n vectors, every basis of V must consist of exactly _____ vectors.

- (A) $n+1$
- (B) n
- (C) $n+1$
- (D) None of these

Solution:

Theorem: If a vector space V has a basis of n vectors, every basis of V must consist of exactly n vectors.

Q.9 An indexed set of vectors $\{v_1, v_2, \dots, v_p\}$ in R^n is said to be _____ if the vector equation $x_1 v_1 + x_2 v_2 + \dots + x_p v_p = 0$ has only the trivial solution.

- (A) Linearly Independent
- (B) Basis
- (C) Linear dependent
- (D) None of these

Solution:

Definition: A linear combination of vectors v_1, v_2, \dots, v_n with coefficients x_1, x_2, \dots, x_n is a vector $x_1 v_1 + x_2 v_2 + \dots + x_n v_n$

Definition: A linear combination $x_1 v_1 + x_2 v_2 + \dots + x_n v_n$ are called trivial if all the coefficients x_1, x_2, \dots, x_n are zero.

Definition: A linear combination $x_1 v_1 + x_2 v_2 + \dots + x_n v_n$ are called non trivial if at least one of them coefficients x_1, x_2, \dots, x_n is not zero.

Definition: The vectors v_1, v_2, \dots, v_n are called linearly independent if there are trivial combination of these vectors equal to the zero vector

Definition: The vectors v_1, v_2, \dots, v_n are called linearly dependent if there are non-trivial combination of these vectors equal to the zero vector

Definition: If a vector V has a basis n , then any set in V containing more than n vectors must be linearly dependent.

Q.10 The set C_n of all root of unity for a fixed positive integer n is a group under _____.

- (A) Addition
- (B) Addition modulo n
- (C) Multiplication
- (D) Multiplication modulo n

Solution:

These are the sets of roots of unity

$$C_2 = \{1, -1\}$$

$$C_3 = \{1, \omega, \omega^2\}$$

$$C_4 = \{1, -1, i, -i\}$$

Clearly all these are group under multiplication

Q.11 Intersection of any collection of _____ normal _____ subgroup
G _____.

- (A) Is normal subgroup
- (B) May not be normal subgroup
- (C) Is cyclic subgroup
- (D) Is Abelian subgroup

Solution:

Theorem: The intersection of two normal subgroups is normal subgroup. If $X \leq G, Y \leq G$ then $(X \cap Y) \leq G$

Q.12 $\frac{Z}{2Z}$ is a quotient group of order _____.

- (A) 1
- (B) 2
- (C) Infinite
- (D) None of these

Solution:

The order of quotient group G/H is given by lagrange Theorem