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Symmetric Group : A collection of all permutations on the set S = {1, 2, 3, ..., n} is define a group under composition of function and denoted by S_n. It is called a symmetric group.

Example : S_1, S_2, S_3, S_4 .... all are symmetric group.

Order of symmetric group : The order of symmetric group S_n is n!.

Note :

Types of permutation in S_3 are I, (ab), (abc)

Types of permutation in S_4 are I, (ab), (abc), (abcd), (ab)(cd)

Type of permutation in S_n are partition of n.

<u>Note :</u>

(1)   The maximum order of elements in S_3 are 3.

(2)   The maximum order of elements in S_4 are 4.

(3)   The maximum order of elements in S_5 are 6.

Number of r-cycles in S_n

Number of cycles of length r in S_n are $^nC_r (r-1)! = \dfrac{n!}{r(n-r)!}$.

Number of product of disjoint cycles in S_n

$$= \dfrac{n!}{\alpha_1^{k_1} . \alpha_2^{k_2} ..... \alpha_i^{k_i} . k_1! \, k_2! ..... k_i!}$$

Where α_i is order of cycle and k_i are repeated number of cycles of order α_i.

Alternating Group :

The group of all even permutation of S_n under composition of function is called alternating group and denoted by A_n.

Order of alternating group $O(A_n) = \dfrac{n!}{2}$.

Q.1. Let S_7 denote the group of permutation of the set $\{1, 2, 3, 4, 5, 6, 7\}$. which of the following is true.

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(a) There are no elements of order 6 in S_7

(b) There are no elements of order 7 in S_7

(c) There are no elements of order 8 in S_7

(d) There are no elements of order 10 in S_7

Q.2. Which of the following numbers can be orders of permutation σ of 11 symbols such that σ does not fix any symbol CSIR NET DEC. 2011

(a) 18

(b) 30

(c) 15

(d) 28

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Q.3. The number of elements in the set $\{x \in S_3 : x^4 = e\}$ is

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(a) 1   (b) 2   (c) 3

(d) 4

Q.4. The order of elements $(123)(245)(456)$ in the group S_6 is   **IIT - JAM-2018**

(a) 1

(b) 2

(c) 4

(d) 6

Q.5. The maximum order of a permutation σ in the symmetric group S_{10} is **IIT – JAM 2017**

(a) 10

(b) 30

(c) 5

(d) 100

Q.6. Number of elements of order 4 in $Z_4 \times S_4$ are

(a) 30   (b) 24

(c) 25   (d) Not exist

Q.7. Let σ be an element of permutation group S_5. Then the maximum possible order of σ is **IIT – JAM 2016**

(a) 5

(b) 6

(c) 10

(d) 15

Q.7. Let A_6 be the group of even permutation of 6 distinct symbols, then the number of elements of order 6 in A_6 are **IIT – JAM-2018**

(a) 0

(b) 1

(c) 3

(d) 6

Q.8. If $\alpha = (1\ 3)(2\ 5\ 4)$ in the symmetric group S_5, then α^{65} equals **IIT - JAM 2011**

(a) $(1\ 3)(2\ 5\ 4)$

(b) $(1\ 2)(3\ 4\ 5)$

(c) $(3\ 2)(1\ 5\ 4)$

(d) $(3\ 1)(2\ 4\ 5)$

Q.9. The number of elements of S_5 (the symmetric group of 5 letters) which are their own inverses equals
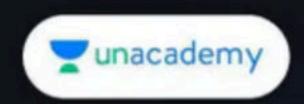
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(a) 10

(b) 11

(c) 25

(d) 26

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