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Courses » Theory of groups for physics applications

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Unit 7 - Week 6

Week 6-Assignment 6-MCQ

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2018-09-12, 23:59 IST.

1) Given that in some representation D, the following elements of S_3 are represented as *1 point*

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix} = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix} \equiv D_2; \quad \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix} \equiv D_3$$

Find the weightages W_i of the irreducible representations D_i (i =1,2,3) in D (D_1 denotes the identity element).

- $W_1 = 1, W_2 = 0, W_3 = 1$
- $W_1 = 1, W_2 = 1, W_3 = 1$
- $W_1 = 1, W_2 = 0, W_3 = 2$
- $W_1 = 1, W_2 = 2, W_3 = 1$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$W_1 = 1, W_2 = 0, W_3 = 1$

2) The multiplication table of a group is given in table 1. *1 point*

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	E	A	B	C	K	L	M	N
E	E	A	B	C	K	L	M	N
A	A	K	N	B	L	E	C	M
B	B	C	K	L	M	N	E	A
C	C	M	L	K	N	B	A	E
K	K	L	M	N	E	A	B	C
L	L	E	C	M	A	K	N	B
M	M	N	E	A	B	C	K	L
N	N	B	L	E	C	M	A	K

Table 1.

Identify all the conjugacy classes.

- {E}, {K}, {A,L}, {C,N}
- {E}, {K}, {A,L}, {B,M}
- {E}, {K}, {A,L}, {C,N}, {B,M}
- {E}, {K}, {A,L}, {C,N}, {B,M}, {A,B,C}

No, the answer is incorrect.
Score: 0

Accepted Answers:
{E}, {K}, {A,L}, {C,N}, {B,M}

3) Given the great orthogonality theorem for unitary representations α and β **1 point**

$$\sum_{g\in G} D^{(\alpha)}_{il}(g) D^{(\beta)*}_{jm}(g) = \frac{|G|}{n_\alpha} \delta_{ij}\delta_{ml}\delta^{\alpha\beta}$$

Obtain a similar statement for the characters of the representations.

- $\sum_{g\in G} \chi^{(\alpha)*}(g)\chi^{(\beta)*}(g) = |G|\delta^{\alpha\beta}$
- $\sum_{g\in G} \chi^{(\alpha)*}(g)\chi^{(\beta)}(g) = |G|\delta^{\alpha\beta}$
- $\sum_{g\in G} \chi^{(\alpha)}(g)\chi^{(\beta)}(g) = |G|\delta^{\alpha\beta}$
- $\sum_{g\in G} \chi^{(\alpha)}(g)\chi^{(\beta)*}(g) = |G|\delta^{\alpha\beta}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sum_{g\in G} \chi^{(\alpha)}(g)\chi^{(\beta)*}(g) = |G|\delta^{\alpha\beta}$

4) If Γ is a d dimensional irreducible representation of a group G and B is a $d \times d$ matrix such that $\Gamma(T)B = B\Gamma(T)$ for every $T \in G$, then B must be a/an **1 point**

- Null matrix.
- Idempotent matrix.
- Multiple of the unit matrix
- No conclusions regarding he matrix nature can be drawn

No, the answer is incorrect.

Score: 0

Accepted Answers:
Multiple of the unit matrix

5) For a specific representation, $\Gamma(E) = \mathbb{I}_{n\times n}$ for the identity E of a group G, then the character $\chi(E)$ will be **1 point**

- 1
- n
- ${}^nC_2$
- $n!$

No, the answer is incorrect.
Score: 0

Accepted Answers:
n

6) "For two representations of a group to be equivalent, they must have identical character systems" -- This statement is **1 point**

- a necessary condition but not sufficient.
- a sufficient condition but not necessary.
- both necessary and sufficient.
- not a valid condition.

No, the answer is incorrect.
Score: 0

Accepted Answers:
a necessary condition but not sufficient.

7) For a finite group G, the number of inequivalent irreducible representations is equal to the **1 point**

- number of generator(s) of G
- number of conjugacy class(es) of G
- order of group G
- number of factor groups of G

No, the answer is incorrect.
Score: 0

Accepted Answers:
number of conjugacy class(es) of G

8) Dimensions d_i of the inequivalent irreducible representations of the crystallographic point group D_4 are **1 point**

- $d_1 = d_2 = d_3 = d_4 = 2, d_5 = 1$
- $d_1 = d_2 = d_3 = d_4 = 1, d_5 = 2$

$d_1 = d_2 = d_3 = 1, d_4 = d_5 = 2$

None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$d_1 = d_2 = d_3 = d_4 = 1, d_5 = 2$

9) Consider a group which contains of an element g of order m i.e. such that $g^m = I$, when represented by an $n \times n$ matrix satisfies ***1 point***

$$\chi(g) = \sum_{k=1}^{n} \lambda_k$$

where λ_m is m^{th} root of unity. Using the above property and algebraic properties of character tables, supply the "?" entry.

Class\Irrep	$\chi^{(1)}$ $n_{(1)}=1$	$\chi^{(2)}$ $n_{(2)}=1$	$\chi^{(3)}$ $n_{(3)}=1$	$\chi^{(4)}$ $n_{(4)}=3$
C_1	1	1	1	?
C_2	1	λ_3	λ_3^2	0
C_3	1	λ_3^2	λ_3	0
C_4	1	1	1	-1

1

2

3

4

No, the answer is incorrect.
Score: 0

Accepted Answers:
3

10) Consider the set of 3×3 matrices $M(a)$ with $a \in \mathbb{R}$ ***1 point***

$$M(a) = \begin{pmatrix} 1 & 0 & 0 \\ a & 1 & 0 \\ a^2 & 2a & 1 \end{pmatrix}$$

This representation can be termed as

Faithful

Unfaithful

Trivial

Equivalent

No, the answer is incorrect.
Score: 0

Accepted Answers:
Faithful

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