PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Group Theory - CSIR NET Physics PYQs

Mathematical Physics . All PYQs (2015-2025) with answer key

6 questions . Answer key included

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Q1. [Dec 2016] . 5.0 marks

Mathematical Physics > Group Theory

CSIR NET	2016 Dec	5M

The 2×2 identity matrix I and the Pauli matrices $\sigma^x, \sigma^y, \sigma^z$ do not form a group under matrix multiplication. The minimum number of 2×2 matrices, which includes these four matrices, and form a group (under matrix multiplication) is

1. 20
2. 8
3. 12
4. 16

Q2. [June 2016] . 5.0 marks

Mathematical Physics > Group Theory

CSIR NET	2016 June	5M

A part of the group multiplication table for a six element group $G = \{e, a, b, c, d, f\}$ is shown below. (In the following e is the identity element of G.)

	e	a	b	c	d	f
e	e	a	b	c	d	f
a	a	b	e	d		
b	b	e	x	f	y	z
c	c					
d	d					
f	f					

The entries x, y and z should be

1. $x = a, y = d$ and $z = c$
2. $x = c, y = a$ and $z = d$
3. $x = c, y = d$ and $z = a$
4. $x = a, y = c$ and $z = d$

Q3. [Dec 2017] . 5.0 marks

Mathematical Physics > Group Theory

CSIR NET	2017 Dec	5M

Consider an element $U(\varphi)$ of the group $SU(2)$, where φ is any one of the parameters of the group. Under an infinitesimal change $\varphi \to \varphi + \delta\varphi$, it changes as $U(\varphi) \to U(\varphi) + \delta U(\varphi) = (1 + X(\delta\varphi))U(gj)$. To order $\delta\varphi$, the matrix $X(\delta\varphi)$ should always be

1. positive definite
2. real symmetric
3. Hermitian
4. anti-hermitian

Q4. [June 2017] . 5.0 marks

Mathematical Physics > Group Theory

CSIR NET	2017 June	5M

Which of the following sets of 3×3 matrices (in which a and b are real numbers) forms a group under matrix multiplication?

1. $\left\{\begin{pmatrix} 1 & 0 & a \\ 0 & 1 & 0 \\ b & 0 & 1 \end{pmatrix}; a, b \in \mathbb{R}\right\}$

2. $\left\{\begin{pmatrix} 1 & a & 0 \\ 0 & 1 & b \\ 0 & 0 & 1 \end{pmatrix}; a, b \in \mathbb{R}\right\}$

3. $\left\{\begin{pmatrix} 1 & 0 & a \\ 0 & 1 & b \\ 0 & 0 & 1 \end{pmatrix}; a, b \in \mathbb{R}\right\}$

4. $\left\{\begin{pmatrix} 1 & a & 0 \\ b & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}; a, b \in \mathbb{R}\right\}$

Q5. [Dec 2023] . 5.0 marks

Mathematical Physics > Group Theory

CSIR NET	2023 Dec	5 M

The regular representation of two nonidentity elements of the group of order 3 are given by

1. $\begin{pmatrix}0&1&0\\1&0&0\\0&0&1\end{pmatrix}, \begin{pmatrix}0&0&1\\0&1&0\\1&0&0\end{pmatrix}$
2. $\begin{pmatrix}1&0&0\\0&0&1\\0&1&0\end{pmatrix}, \begin{pmatrix}0&1&0\\1&0&0\\0&0&1\end{pmatrix}$
3. $\begin{pmatrix}0&0&1\\1&0&0\\0&1&0\end{pmatrix}, \begin{pmatrix}0&1&0\\0&0&1\\1&0&0\end{pmatrix}$
4. $\begin{pmatrix}0&0&1\\0&1&0\\1&0&0\end{pmatrix}, \begin{pmatrix}0&0&1\\1&0&0\\0&1&0\end{pmatrix}$

Q6. [June 2024] . 5.0 marks

Mathematical Physics > Group Theory

CSIR NET	2024 June	5M

The following four matrices form a representation of a group

$$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, A = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix},$$
$$B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, C = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$$

Which of the following represents the multiplication table for the same group?

1.

	I	A	B	C
I	I	A	B	C
A	A	I	C	B
B	B	C	A	I
C	C	B	I	A

2.

	I	A	B	C
I	I	A	B	C
A	A	B	C	I
B	B	C	I	A
C	C	I	A	B

3.

	I	A	B	C
I	I	A	B	C
A	A	C	I	B
B	B	I	C	A
C	C	B	A	I

4.

	I	A	B	C
I	I	A	B	C
A	A	I	C	B
B	B	C	I	A
C	C	B	A	I

Answer Key

6 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Mathematical Physics	Group Theory	**4**
Q2	Mathematical Physics	Group Theory	**4**
Q3	Mathematical Physics	Group Theory	**4**
Q4	Mathematical Physics	Group Theory	**3**
Q5	Mathematical Physics	Group Theory	**3**
Q6	Mathematical Physics	Group Theory	**4**

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