Subjective Type

MCQ's

1) c (3x2)
2) b (Monoid)
3) d (singular)
4) a ($a^{-1}b$)

Long Answer

let $G = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix}, a,b,c,d \in R, ad - bc \neq 0 \right\}$

C-1 let. $A, B \in G$

$$A = \begin{bmatrix} a_1 & b_1 \\ c_1 & d_1 \end{bmatrix}, B = \begin{bmatrix} a_2 & b_2 \\ c_2 & d_2 \end{bmatrix}$$

$$A \cdot B = \begin{bmatrix} a_1 & b_1 \\ c_1 & d_1 \end{bmatrix} \cdot \begin{bmatrix} a_2 & b_2 \\ c_2 & d_2 \end{bmatrix} = \begin{bmatrix} a_1a_2+b_1c_2 & a_1b_2+b_1d_2 \\ c_1a_1+d_1c_2 & c_1b_2+d_1d_2 \end{bmatrix} = G$$

G is closed under multiplication

because in matrices, $\forall A, B, C \in G$

$(A \cdot B) \cdot C = A \cdot (B \cdot C)$

C-3 $I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \in G \quad \forall A \in G$

$A I_2 = A = I_2 A$

C-4 $\forall A \in G \; \exists A^{-1} \in G$ such that

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	A	B	C	D
1	○	○	●	○
2	●	○	○	●
3	○	○	○	●
4	●	○	○	○
5	○	●	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○

Marks Obtained

$A \cdot A^{-1} = I_2 = A^{-1}A$

we can check it as

if

$$A = \begin{bmatrix} a_1 & b_1 \\ c_1 & d_1 \end{bmatrix}$$

then

$$A^{-1} = \frac{\text{Adj}A}{|A|} = \frac{1}{a_1d_1 - b_1c_1}\begin{bmatrix} d_1 & -b_1 \\ -c_1 & a_1 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{d_1}{a_1d_1 - b_1c_1} & \frac{-b_1}{a_1d_1 - b_1c_1} \\ \frac{-c_1}{a_1d_1 - b_1c_1} & \frac{a}{a_1d_1 - b_1c_1} \end{bmatrix} \in G$$

$\Rightarrow$ Inverse of each element in G exist in G

c-5 In matrices, we know that

$\forall A, B \in G$

$A \cdot B \neq B \cdot A$

$\Rightarrow$ commutative law does not hold in G

$\Rightarrow$ G from a non-Abelian group under multiplication.

SHORT ANSWER

Qno1:

A semi group is an algebraic structure consisting of a set together with an associative binary operation.
The binary operation of a semigroup is most often denoted multiplicatively x.y ore simply xy.

Qno2

*	0	1	2	3	4
0	0	0	0	0	0
1	0	1	2	3	4
2	0	2	4	1	3
3	0	3	1	4	2
4	0	4	3	2	1

$2 \times 3 = 6 = 1$
$2 \times 4 = 8 = 3$
$3 \times 3 = 9 = 4$
$3 \times 4 = 12 = 2$
$4 \times 4 = 16 = 1$

Qno3

$$A = \begin{bmatrix} i & 0 \\ 1 & -i \end{bmatrix}, \quad A^4 = I_2$$

$$A \times A = \begin{bmatrix} i & 0 \\ 1 & -i \end{bmatrix} \times \begin{bmatrix} i & 0 \\ 1 & -i \end{bmatrix}$$

$$A^2 = \begin{bmatrix} i^2+0 & 0-0 \\ i-0 & 0+i^2 \end{bmatrix}$$

$$A^2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$A^2 \times A^2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} \times \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$A^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$A^4 = I_2$$