

Source: [KB20200825132400](#)

1 | Groups

- definition
 - closed
 - if $a, b \in S$ then $a + b \in S$
 - has an identity e
 - $e + a = a + e = a$
 - each element has an inverse
 - $-a + a = a + -a = e$
 - needs to be associative
 - $(a + b) + c = a + (b + c)$
- commutativity is nice but not required
 - $a + b = b + a$
- Which number systems are groups under addition and multiplication? | Number System | Multipli-
cation | Addition | | — — — — — | : — — — — — | : — — — — — | | Natural Numbers | No inverse | No identity | |
Whole Numbers | No inverse | No inverse | | Integers | No inverse | Yes | | Rationals | Yes | Yes | | Reals
| Yes | Yes | | Complex Numbers | Yes | Yes |
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$$\begin{bmatrix} 8 & 2 \\ -2 & 0 \end{bmatrix}$$
