closure property:

(+) $5+2=7$ | $9+8=17$

$5,2,7 \in Z$. | $9,8,17 \in Z$.

$5,2 \in Z$; $5+2=7 \in Z$

$9,8 \in Z$; $9+8=17 \in Z$

closure property is satisfied for addition on 'Z'

(−) $9-7=2$ | $4-3=1$

$9,7,2 \in Z$ | $4,3,1 \in Z$

$9,7 \in Z$; $9-7=2 \in Z$

$4,3 \in Z$; $4-3=1 \in Z$

$5,7 \in Z$; $5-7=-2 \in Z$

closure property is satisfied for subtraction on Z.

(×) $5 \times 2 = 10$ | $6 \times 3 = 18$

$5,2 \in Z$, 10 also $\in Z$. | $6,3,18 \in Z$

closure property satisfies for multiplication.

(÷) $5 \div 2 =$ 2 quitint (quotient) is '2', reminder is not '0'; $5,2 \in Z$ but $\frac{5}{2} \notin Z$

closure property Does not $\in$ to Division. on 'Z'. (is not satisfied for)

associative property:

+ $(2+5)+1 = 2+(5+1)$
$8 \quad = 8$

$(1+2)+3 = (3+1)+2$ ✗
$6 \quad 6$

$1+(2+3)$

addition is associative on $\mathbb{Z}$.

− $(5-1)-2 \neq 5-(1-2)$
$4-2 \quad 5-(-1)$
$2 \quad 6$

$5-(2-1)$ ✗
$=5-1=4$

$(6-3)-4 \neq 6-(3-4)$
$3-4 \neq 6-(-1)$
$-1 \quad +7$

subtraction is not associative on $\mathbb{Z}$.

× $(2\times3)\times4 = 2\times(3\times4)$
$6\times4 \quad 2\times12$
$24 \quad 24$

$(2\times4)\times1 = 2\times(4\times1)$
$8\times1 \quad 2\times4$
$8 \quad 8$

multiplication is associative on $\mathbb{Z}$ ✓

÷) $(6 \div 2) \div 2 \neq 6 \div (2 \div 2)$

$3 \div 2$

quotient = 1

remainder = 1

$6 \div 1$

6

$\neq$

$(9 \div 3) \div 2 \neq 9 \div (3 \div 2)$

$3 \div 2$

$q = 1$

$R = 1$

$9 \div 1$ (R = 1; q = 1;)

9

division is not associative in $\mathbb{Z}$.

Distributive property:

+) $3 \times (1 + 2) = (3 \times 1) + (3 \times 2)$

$3 \times 3 = 3 + 6$

$9 \quad 9$

+ is Distributive in $\mathbb{Z}$.

$6 \times (2 + 3) = (6 \times 2) + (6 \times 3)$

$6 \times 5 = 12 + 18$

$30 \quad 30$

-) $3 \times (4 - 5) \mid (3 \times 4) - (3 \times 5)$

$3 \times (-1) \mid 12 - 15$

$-3 \quad = \quad -3$

$-$ is distributive in $\mathbb{Z}$.

$2 \times (6 - 3) \mid (2 \times 6) - (2 \times 3)$

$2 \times 3 \mid 12 - 6$

$6 \quad = \quad 6$

commutative property:

+) $3+2=2+3$ $\quad 3+9=9+3$

$5=5$ $\quad 12=12$

+ is commutative in $\mathbb{Z}$.

−) $2-3 \neq 3-2$ $\quad 9-2 \neq 2-9$

$-1 \quad 1 \quad 7 \quad -7$

− is not commu-tative in $\mathbb{Z}$.

×) $4 \times 3 = 3 \times 4$ $\quad 9 \times 2 = 2 \times 9$

$12 \quad 12 \quad 18 \quad 18$

× is communitative in $\mathbb{Z}$.

÷) $4 \div 2 \neq 2 \div 4$ $\quad 9 \div 2 \neq 2 \div 9$

$2 \quad 0 \quad q=4 \quad q=0$

÷ is not commutative R/ on $\mathbb{Z}$.

closure property on Q:

+) $6.2 + 9.2 = 15.4$ | $1.3 + 4.5 = 5.8$

$6.2, 9.2 \in Q$

$6.2 + 9.2 \in Q.$

$1.3, 4.5 \in Q$

$1.3 + 4.5 \in Q.$

+ is closure on Q.

-) $2.3 - 6.1 = -3.8$ / $6.2 - 4.1 = 2.1$

$2.3, 6.1 \in Q$

$2.3 - 6.1 \in Q.$

$6.2, 4.1 \in Q$

$6.2 - 4.1 \in Q.$

- is closure on Q

x] 1.1×6.2 / 2.3×1.6

6.82 / 3.68

$1.1, 6.2 \in Q$

$1.1 \times 6.2 \in Q$.

$2.3, 1.6 \in Q$

$2.3 \times 1.6 \in Q$.

x is closure on Q.

÷] $6.2 \div 1.1$

$5.636363363...$

$6.2, 1.1 \in Q$.

$6.2 \div 1.1 \in Q$

÷ is closure on Q.

$9.1 \div 6.3 = 1.444444...$

$9.1, 6.3 \in Q$

$9.1 \div 6.3 \in Q$

associative property:

$$\left.\begin{array}{l|l} (6.2+9.8)+2.1 & 6.2+(9.8+2.1) \\ 16+2.1 & 6.2+11.9 \\ 18.1 = & 18.1 \end{array}\right\} +$$

$$\begin{array}{l|l} (1.2+6.1)+6.0 & 1.2+(6.1+6.0) \\ 7.3+6.0 & 1.2+12.1 \\ 13.3 = & 13.3 \end{array}$$

$+$ is associative in $\mathbb{Q}$.

-) $(9.9-2.3)-1.1 \neq 9.9-(2.3-1.1)$

$7.6-1.1 \neq 9.9-1.2$

$6.5 \neq 8.7$

$(5.5-9.2)-6.6 \neq 5.5-(9.2-6.6)$

$-3.7-6.6 \neq 5.5-2.6$

$-10.3 \neq 2.9$

- is not associative in Q.

x) $(9.6 \times 2.1) \times 11.2 \mid 9.6 \times (2.1 \times 11.2)$

$20.16 \times 11.2 \mid 9.6 \times 23.52$

$225.792 = 225.792$

$(55.22 \times 11.2) \times 1.11$ | $55.22 \times (11.2 \times 1.11)$

618.464×1.11 | 55.22×12.432

$686.49504 = 686.49504$

$\times$ is associative on $\mathbb{Q}$.

) $(5.5 / 2.2) / 9.1$ | $5.5 / (2.2 / 9.1)$

$2.5 / 9.1$ | $5.5 / 0.241758\ldots$

$0.274725\ldots \neq 21.750022750\ldots$

$\div$ is not associative on $\mathbb{Q}$.

Distributive property: $a \times (b - c) = a \times b - a \times c$

$6.2 \times (9.1 + 6.3)$

6.2×15.4

95.48

$=$

$6.2 \times 9.1 + 6.2 \times 6.3$

$56.42 + 39.06$

95.48

$9.1 \times (6.1 + 999.999)$

9.1×1006.099

9155.5009

$=$

$9.1 \times 6.1 + 9.1 \times 999.999$

$55.51 + 9099.9909$

9155.5009

+ is distribute on ×.

$9.26 \times (9.99 - 8.1)$

9.26×1.89

17.5014

$=$

$9.26 \times 9.99 - 9.26 \times 8.1$

$92.5074 - 9.26 \times 8.1$

17.5014

$3.05 \times (9.9 - 2.1)$ $=$ $3.05 \times 9.9 - 3.05 \times 2.1$

3.05×7.8 $=$ $30.195 - 3.05 \times 2.1$

23.79 $=$ 23.79

$-$ is distributive on $\times$.

Commutative property

+) $9.1 + 2.1 = 11.2$ $\quad$ $2.1 + 9.1 = 11.2$ $\quad$ $5.1 + 6.2 = 11.3$ $\quad$ $6.2 + 5.1 = 11.3$

$+$ is commutative on $\mathbb{Q}$.

−) $9.1 - 8.1 = 1.0$ $\quad$ $8.1 - 9.1 \neq -1.0$ $\quad$ $9.9 - 8.6 = 1.3$ $\quad$ $8.6 - 9.9 \neq -1.3$

$-$ is not commutative on $\mathbb{Q}$.

x) $9.99 \times 8.1 = 8.1 \times 9.99$
$80.919 = 80.919$

$6.1 \times 9.1 = 9.1 \times 6.1$
$55.51 = 55.51$

$\times$ is commutative on $\mathbb{Q}$.

$\div$) $5.5 \div 2.1 \neq 2.1 \div 5.5$
$2.6190\ldots \neq 0.381818\ldots$

$9.99 \div 1.11 \neq 1.11 \div 9.99$
$9.0 \neq 0.\overline{1}$

$\div$ is not commutative on $\mathbb{Q}$.