

# MTH 4441 Homework #1 - Binary Operators

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In exercises 1-7, determine whether:

- i)  $*$  is a binary operation on  $S$
- ii)  $*$  is commutative
- iii)  $*$  is associative

Where appropriate, we may use the facts that addition and multiplication of integers and/or real numbers is both commutative and associative.

You may also make reference to the fact that the operations of addition and multiplication are “closed” on the integers and real numbers.

1.  $S = \mathbb{Z}$  and  $a * b = 2a + 2b$

2.  $S = \mathbb{Z}$  and  $a * b = a + 2b$

3.  $S = \mathbb{Z}$  and  $a * b = 2a - 2b$

4.  $S = \mathbb{R}$  and  $a * b = \frac{a}{b}$

5.  $S = \mathbb{R}^+$  and  $a * b = \frac{a}{b}$

6.  $S = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} : a, b, c, d \in \mathbb{R} \right\}$  and  $A * B = A + B$  (The usual matrix addition)

7.  $S = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} : a, b, c, d \in \mathbb{R} \right\}$  and  $A * B = AB$  (The usual matrix multiplication)