MTH 4441 Homework Exercises #1
Due Wednesday Sept 6

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1. In each case below, determine whether $*$ is a **closed** binary operation on the given set. If it *IS* a **closed** binary operation, then determine whether it is commutative and/or associative.

   (a) $(\mathbb{Z}, *)$ where $a * b = a + b^2$

   (b) $(\mathbb{Z}, *)$ where $a * b = a^2 b^3$

   (c) $(\mathbb{R}, *)$ where $a * b = \frac{a}{a^2 + b^2}$

   (d) $(\mathbb{Z}, *)$ where $a * b = \frac{a^2 + 2ab + b^2}{a + b}$

   (e) $(\mathbb{Z}, *)$ where $a * b = a + b - ab$

   (f) $(\mathbb{R}, *)$ where $a * b = b$

   (g) $(S, *)$ where $S = \{-4, -2, 1, 2, 3\}$, and $a * b = |b|$

   (h) $(\{1, 2, 3, 6, 18\}, *)$ where $a * b = ab$

   (i) $\left(\left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} : a, b, c, d \in \mathbb{R} \right\}, * \right)$ where $*$ is matrix addition