Axioms for the set of numbers $S = \mathbb{Q}$ or $S = \mathbb{R}$

For every $x, y, z \in S$:

$A1)\ x + y \in S$	$M1)\ x \cdot y \in S$	(closure)
$A2)\ (x + y) + z = x + (y + z)$	$M2)\ (x \cdot y) \cdot z = x \cdot (y \cdot z)$	(associativity)
$A3)\ x + y = y + x$	$M3)\ x \cdot y = y \cdot x$	(commutativity)
$A4)\ x + 0 = x$	$M4)\ x \cdot 1 = x$	(identity)
$A5)$ Given $x,$ there is $(-x) \in S$ s.t.	$M5)$ Given $x,$ there is $\frac{1}{x} \in S$ s.t.	
$x + (-x) = 0$	$x \cdot \frac{1}{x} = 1$	(inverse)
$DL)\ x \cdot (y + z) = x \cdot y + x \cdot z$		(distributivity)

Note: Axioms $A1$–$A5$ are also satisfied by set $S = \mathbb{Z}$.

Another note: When writing multiplication, often we omit to write the symbol $\cdot$.

Power of ...

By definition, we write for positive integer n:

$$x^n = \underbrace{x \cdot x \cdot \ldots x}_{n \text{ times}}$$

Very often the value of n is 2. In this case, we call $y = x^2$ the square of x. We have another notation for the inverse of the square of x, $\sqrt{y} = x$. Remember that $\sqrt{y}$ is defined only if y is positive (if we restrict our discussion to set $\mathbb{R}$).

As a consequence of these notations, we have the following rules:

$$x^n \cdot x^m = x^{n+m}$$
$$(x^n)^m = x^{n \cdot m}$$
$$\sqrt{y} = y^{\frac{1}{2}}$$