Here is a list of things you can and can not do in mathematics. This list is based on common mistakes made by students.

1. $\sqrt{a+b}$ is **not** equal to $\sqrt{a}+\sqrt{b}$. For example, $\sqrt{1+1} = \sqrt{2} = 1.41\ldots$, but $\sqrt{1} + \sqrt{1} = 1 + 1 = 2$.

2. $(a+b)^2$ is not equal to $a^2 + b^2$. For example, $(1+1)^2 = 2^2 = 4$, but $1^2 + 1^2 = 1 + 1 = 2$. Remember that the formula which is true is $(a+b)^2 = a^2 + b^2 + 2ab$.

3. Do not break fractions, i.e.

$$\frac{a+b}{c+b} \text{ is \textbf{not} equal to } \frac{a}{c} + \frac{b}{d}$$

If you want to group the sum $\frac{a}{c} + \frac{b}{d}$ into a single expression, then you need to use the least common multiple. For example:

$$\frac{3}{4} + \frac{2}{5} = \frac{5 \times 3 + 4 \times 2}{20} = \frac{23}{20}$$

However, something like that is true for muliplication $\frac{a}{c}\frac{b}{d} = \frac{ab}{cd}$, example: $\frac{3}{4} \times \frac{2}{5} = \frac{6}{20}$

4. If you have a minus sign in front of a parenthesis then it changes the sign of every term inside. For example $2 - (x^2 - 3x + 4) = 2 - x^2 + 3x - 4$ and **not** $2 - x^2 - 3x + 4$.

5. You can not simplify summands in fractions, i.e., the following simplification is **wrong**:

$$\frac{x^2 + 8}{x - 4} = \frac{x^2 + \cancel{8}}{x - \cancel{4}} = \frac{x^2 + 2}{x - 1}$$

The following are useful rules.

1.

$$\frac{\frac{a}{b}}{\frac{c}{d}} = \frac{ad}{bc} \tag{1}$$

i.e., "the first times the **inverse** of the second". For example:

$$\frac{\frac{1}{2}}{\frac{3}{4}} = \frac{1 \times 4}{2 \times 3} = \frac{4}{6}$$

2. $a^x a^y = a^{x+y}$.

3. $(a^x)^y = a^{xy}$.

4. $\log(a+b)$ is **not** equal to $\log(a)+\log(b)$. However, the following is true: $\log(ab) = \log(a) + \log(b)$. The statements made here do not depend on which basis of log we are using.

5. $\log(a^b) = b\log(a)$.

6. $\log(\frac{a}{b}) = \log(a) - \log(b)$.