ISSN: 2639-0108

Research Article

Advances in Theoretical & Computational Physics

On A function with Switch Effect

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Submitted: 2025, May 05; **Accepted:** 2025, Jun 24; **Published:** 2025, Jul 14

Citation: Keitaroh, U. (2025). On A function with Switch Effect. *Adv Theo Comp Phy, 8*(3), 01-04.

Abstract
The content of this paper explains the application of the switch effect of the derivative of $|x|$, and it is by no means a research result on functions with singularities, nor is it a research result on division by zero. This paper has nothing to do with research on singularities or division by zero.

1. The Derivative of |x|

This chapter shows the feature of the derivative of $|x|$.

$x \in R.$

Regarding $y = e^{\int \frac{1}{x} dx} = |x|$, *the following feature is well known.*

Since y *is continuous at* $x = 0, y(0)$ *and* $y'(0)$ *each can have some value.*

$$y(x) = e^{\int \frac{1}{x} dx} = |x|.$$

$$y'(x) = \frac{1}{x} \cdot e^{\int \frac{1}{x} dx} = \frac{|x|}{x}.$$

$\frac{|x|}{x}$ *has a switch effect, where its value changes according to the value of* x *as follows.*

In case $x > 0$, $\frac{|x|}{x} = 1$.
In case $x = 0$, $\frac{|x|}{x} = 0$.
In case $x < 0$, $\frac{|x|}{x} = -1$.

The value of $\frac{|x|}{x}$ *at the origin is* 0 *because it is the value of the slope of the tangent to* $y = |x|$, *which is intuitively visually obvious to humans. The tangent passing through the origin coincides with the x-axis.*

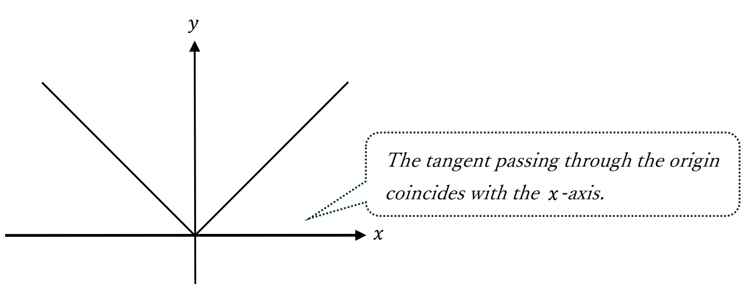

Figure 1: Graph of $y = |x|$

Therefore, $\frac{|0|}{0} = 0$ *is the result of the function with switch effect and is not an artificially defined value. Of course, generally it is not allowed to place* 0 *in the denominator of a fraction, but nevertheless, for that reason above, when the form* $\frac{|0|}{0}$ *appears in any formula or equation, we can adopt the rule that its value is* 0*. This rule is defined by the function with switch effect, and it is a natural gift rooted in the Napier number* **e**.

On the other hand, regarding $|x|$*, from exponential law,*

$$e^{\int \frac{1}{x} dx} \cdot e^{-\int \frac{1}{x} dx} = \frac{|x|}{|x|} = e^0 = 1\,,$$

$by\ setting, x = 0$,

$$\frac{|0|}{|0|} = 1\,.$$

Therefore, $\frac{|0|}{|0|} = 1$ *is a result from exponential law and is not an artificially defined value. Of course, generally it is not allowed to place* $|0|$ *in the denominator of a fraction, but nevertheless, for that reason above, when the form* $\frac{|0|}{|0|}$ *appears in any formula or equation, we can adopt the rule that its value is 1. This rule is based on exponential law, and it is a natural gift rooted in the Napier number* **e**.

2. The Rules of Replace

This chapter shows the rules for replacing undefined symbols with numerical values.

2.1. Rule 1:

$$\frac{|\mathbf{0}|}{\mathbf{0}} = \mathbf{0}.$$

When $\frac{|0|}{0}$ *appears in any formula or equation, it is decided that the* $\frac{|0|}{0}$ *can be replaced with the value* 0.

That is

$$\frac{|\mathbf{0}|}{\mathbf{0}} \cdot \text{undefined} - \text{symbol} = \text{undefined} - \text{symbol} \cdot \frac{|\mathbf{0}|}{\mathbf{0}} = \mathbf{0}\,.$$

2.2. Rule 2:

$$\frac{|\mathbf{0}|}{|\mathbf{0}|} = \mathbf{1}.$$

When $\frac{|0|}{|0|}$ *appears in any formula or equation, it is decided that the* $\frac{|0|}{|0|}$ *can be replaced with the value* 1.

That is

$$\frac{|\mathbf{0}|}{|\mathbf{0}|} \cdot \text{undefined} - \text{symbol} = \text{undefined} - \text{symbol} \cdot \frac{|\mathbf{0}|}{|\mathbf{0}|} = \text{undefined} - \text{symbol}\,.$$

3. Applications of the Rules

This chapter shows the applications by using **Rule 1** *and* **Rule 2** *above.*

3.1.

$$y(x) = |x|\,.$$
$$y'(x) = \frac{|x|}{x}\,.$$

$$\frac{y'(x)}{y'(x)} = \frac{|x|}{x} \cdot \frac{x}{|x|} = \frac{|x|}{|x|} \cdot \frac{x}{x} = \frac{x}{x},$$

by setting $x = 0$,

$$\frac{y'(0)}{y'(0)} = \frac{|0|}{0} \cdot \frac{0}{|0|} = \frac{|0|}{|0|} \cdot \frac{0}{0} = \frac{0}{0} = 0\,.$$

$\frac{0}{0}$ *is an undefined symbol, but when* $\frac{0}{0}$ *appears in any formula or equation, it is decided that the* $\frac{0}{0}$ *can be replaced with value* 0.

3.2.

$$\frac{1}{x} = \frac{1}{x} \cdot \frac{|x|}{|x|} = \frac{|x|}{x \cdot |x|} = \frac{|x|}{x} \cdot \frac{1}{|x|},$$

by setting $x = 0$,

$$\frac{1}{0} = \frac{1}{0} \cdot \frac{|0|}{|0|} = \frac{|0|}{0 \cdot |0|} = \frac{|0|}{0} \cdot \frac{1}{|0|} = 0$$

$\frac{1}{0}$ *and* $\frac{1}{|0|}$ *are undefined symbols, but when* $\frac{1}{0}$ *appears in any formula or equation, it is decided that the* $\frac{1}{0}$ *can be replaced with value* 0.

3.3.

$n \in N.$

$$y(x) = \sum_{i=1}^{n} a_i \left(\frac{1}{x}\right)^i + a_0,$$

by setting $x = 0$,
from 3.2,

$$y(0) = \sum_{i=1}^{n} a_i \left(\frac{1}{0}\right)^i + a_0 = a_0\,.$$

3.4.

$$\frac{x}{|x|} = \frac{1}{\frac{|x|}{x}}\,.$$

by setting $x = 0$,

from 3.2,

$$\frac{0}{|0|} = \frac{1}{\frac{|0|}{0}} = \frac{1}{0} = 0.$$

$\frac{0}{|0|}$ *is an undefined symbol, but when* $\frac{0}{|0|}$ *appears in any formula or equation, it is decided that the* $\frac{0}{|0|}$ *can be replaced with value* 0.

3.5.

From the above,

$$y = |x|\,.$$

$$\frac{y'(x)}{y'(x)} = \frac{\boldsymbol{|x|}}{\boldsymbol{x}} \cdot \frac{x}{|x|} = \frac{|x| \cdot x}{x \cdot |x|} = \frac{|x| \cdot x}{|x| \cdot x} = \frac{\boldsymbol{|x|}}{\boldsymbol{|x|}} \cdot \frac{x}{x} = 1 \cdot \frac{x}{x} = \frac{1 \cdot x}{1 \cdot x} = \frac{1 \cdot x}{x \cdot 1} = \frac{\mathbf{1}}{\boldsymbol{x}} \cdot \frac{\boldsymbol{x}}{\mathbf{1}}\,,$$

$by\ setting\ \ x = 0\,,$

$$\frac{y'(0)}{y'(0)} = \frac{\mathbf{|0|}}{\mathbf{0}} \cdot \frac{0}{|0|} = \frac{|0| \cdot 0}{0 \cdot |0|} = \frac{|0| \cdot 0}{|0| \cdot 0} = \frac{\mathbf{|0|}}{\mathbf{|0|}} \cdot \frac{0}{0} = 1 \cdot \frac{0}{0} = \frac{1 \cdot 0}{1 \cdot 0} = \frac{1 \cdot 0}{0 \cdot 1} = \frac{\mathbf{1}}{\mathbf{0}} \cdot \frac{\mathbf{0}}{\mathbf{1}} = 0\,.$$

Therefore, $\frac{0}{0}$ *and* $\frac{1}{0}$ *are undefined symbols, but* $\frac{0}{0}$ *can be decomposed into two products,* $\frac{1}{0}$ *and* $\frac{0}{1}$ **.**

$Thus, \frac{|0|}{0} = 0\ and\ \frac{|0|}{|0|} = 1\ \ leads\ to\ \frac{0}{0} = \frac{1}{0} \cdot \frac{0}{1} = 0.$

4. Conclusion

4.1. The Result Derived From the Function with Switch Effect

$$\left[\ \frac{\mathbf{|0|}}{\mathbf{0}} = \mathbf{0}\ \boldsymbol{and}\ \frac{\mathbf{|0|}}{\mathbf{|0|}} = \mathbf{1}\right] \rightarrow \left[\ \frac{\mathbf{1}}{\mathbf{0}} = \frac{\mathbf{|0|}}{\mathbf{0}} \cdot \frac{\mathbf{1}}{\mathbf{|0|}} = \mathbf{0}\ \ \boldsymbol{and}\ \ \frac{\mathbf{0}}{\mathbf{0}} = \frac{\mathbf{1}}{\mathbf{0}} \cdot \frac{\mathbf{0}}{\mathbf{1}} = \mathbf{0}\ \right].$$

$\frac{0}{0}$ *can be decomposed into two products,* $\frac{1}{0}$ *and* $\frac{0}{1}$*.*

I believe that the Napier number **e** *will guide us humans on the path to a correct understanding of providence.*

References

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