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Title: **THE TURNING POINT OF A FUNCTION GRAPH AND ITS DIVISION INTO TYPES**

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# THE TURNING POINT OF A FUNCTION GRAPH AND ITS DIVISION INTO TYPES

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**Abstract:** In the existing textbooks and manuals, the turning points of the function graph are studied only for the continuity points of the functionIn. Fact, in studying the problem of simply constructing a function graph, the point that separates the concave (convex) and convex (concave) of a function graph is the continuity point or breakpoint of the function, which may or may not belong to the domain of the function

**Keywords**: In fact, simply constructing, function graph, circumference

## Introduction

When constructing a function graph on characteristic points and in some other matters, it is important to find the turning points of the function graph and to have sufficient information about them.

In the existing textbooks and manuals, the turning points of the function graph are studied only for the continuity points of the function.

For example, in the existing textbooks and manuals, let's give examples from the descriptions given to the turning point of the function graph:

Let the function $f(x)$ be given in the set $X$.

$$U_\delta(x_0)=\{x: x_0-\delta<x<x_0, \delta>0\}=(x_0-\delta, x_0+\delta_0),$$

$$U_\delta^-(x_0)=\{x: x_0-\delta<x<x_0, \delta>0\}=(x_0-\delta, x_0),$$

$$U_\delta^+(x_0)=\{x: x_0-\delta<x<x_0, \delta>0\}=(x_0, x_0+\delta)$$

the sets are called $\delta$ circumference of the point $x_0$, $\delta$ circumference of the left, $\delta$ circumference of the right, respectively.

**Definition 1**. If the function $f(x)$ is concave (convex) in the interval $U_\delta^-(x_0)$ and convex (concave) in the interval $U_\delta^+(x_0)$, then the point $x_0$ is called the turning or bending point of the graph of the function. [1], [2], [3], [4].

**Definition 2.** Suppose that the function $y=f(x)$ is defined around a point $x_0$ and is continuous at point $x_0$. If the curve $y=f(x)$ changes its convex direction when the variable x point "passes" through the point $x_0$, then the point $(x_0; f(x_0))$ is called the bending or turning point of the graph of the function $f=f(x)$. ([5], [6], [7].

In definition 1, given the inflection (bending) point of the function graph, the inflection point is given only by the abscissa $x_0$, while in definition 2, the inflection (inflection) point is given by the $(x_0; f(x_0))$ coordinates.

In fact, in studying the problem of simply constructing a function graph, the point that separates the concave (convex) and convex (concave) of a function graph is the continuity point or breakpoint of the function, which may or may not belong to the domain of the function. Many such features can be cited. Therefore, would it be more appropriate to describe and categorize in a broader sense the point that separates the concave (convex) and convex (concave) of a function graph?

We propose to approach this issue as follows:

First of all, let us define the turning (bending) point of the graph of the function as follows.

**Defition 3**. If the function $f(x)$ is convex (convex) in the interval $U_\delta^-(x_0)$ and convex (concave) in the interval $U_\delta^+(x_0)$, then the point $x_0$ is the continuity point or breakpoint of the function, and the point $x_0$ is the point of inflection of the function graph, whether or not it belongs to the domain of the function, called

When classifying the inflection (inflection) point of a function graph in such a way, the class of inflection (inflection) points expands. Also, for the turning (bending) point, one of the following 3 cases would be appropriate.

**Case 1.** The point $x = x_0$ is the turning point of the function graph, and the function $x_0$ continuous at the point.

**Case 2**. The point $x = x_0$ is the turning point of the function graph, and the function has an interruption at point $x_0$, but the point $x_0$ belongs to the domain of the function.

**Case 3**. Point $x = x_0$ is the turning point of the function graph, and the function has a break at point $x_0$, but, point $x_0$ does not belong to the domain of the function.

Given the above cases (cases 1,2,3) for the turning points of the function graph, let us give specific definitions of the turning points of the function graph as follows:

**Definition 4.** Suppose that the function $f(x)$ is concave in the interval $U_\delta^-(x_0)$ and convex in the interval $U_\delta^+(x_0)$.

1). If the function at point $x_0$ is continuous, then point $x = x_0$ is called the characteristic turning point of the function graph.

2). If the function at point $x_0$ has a break, and point $x_0$ belongs to the domain of the function, then the point $x = x_0$ is called the relative characteristic turning point of the function graph.

3). If the function at point $x_0$ has a discontinuity and the point $x_0$ does not belong to the domain of the function, then the point $x = x_0$ is called the inverse of the function graph.

In the tariffs given in this view, the specific or relative specific turning points can be expressed directly with $(x_0; f(x_0))$ coordinates, and the specific specific turning points can be represented only by the abscissa of the turning point.

It is known that in case 1, that is, in the existing textbooks and manuals, sufficient information is given about the specific turning point of the graph of the function.

For other cases (relative specific and non-specific) the turning points can be named with more precision:

According to the type of interruption of the function at the relative characteristic turning point $(x_0; f(x_0))$ of the function graph:

- the relative characteristic turning point at which the relativity can be eliminated,

- the relative characteristic turning point with the first round interruption,

- can be called a relative characteristic turning point with a second round break.

Also, according to the type of interruption of the function at the inherent turning point $x = x_0$ of the function graph:

- non-specific turning point, which can be eliminated

- the characteristic turning point with the first round interruption,

- can be called a non-specific turning point with a second round break.

Now let's give examples of the (named) torsion points above.

We are limited to examples that are simple and easy to compare.

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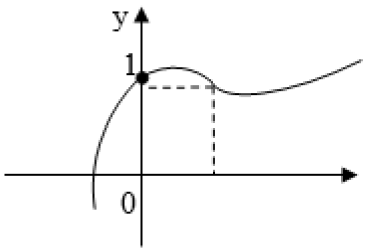
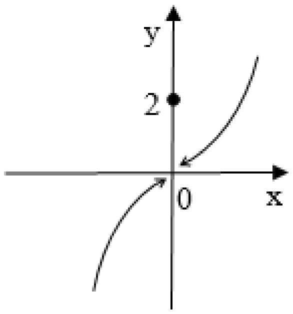
**1-example**.

Function $f(x) = x^3 - x^2 + 1$ has characteristic turn

at point $\left(\frac{1}{3}; \frac{25}{27}\right)$



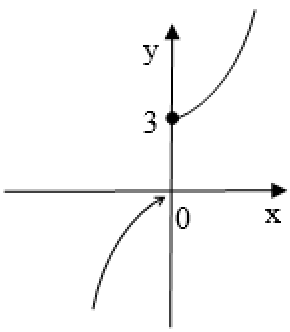

**2-example**. $f(x) = \begin{cases} -x^2 & агар \quad x < 0 \\ 2 & агар \quad x = 0 \\ x^2 & агар \quad x > 0 \end{cases}$




(0;2)) point for function which can eliminate relativity will be a relative characteristic turning point

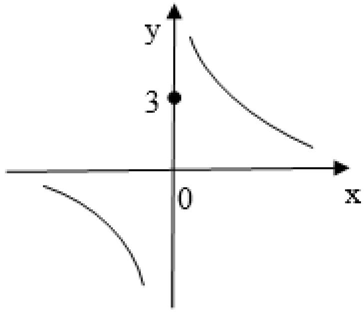
**3-example**.

$f(x) = \begin{cases} -x^2 & агар \quad x < 0 \\ x^2 + 3 & агар \quad x \geq 0 \end{cases}$



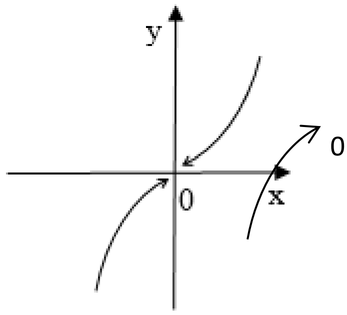

(0;3)) point for function the first round has a Break which is the relative characteristic turning point.

**4-example**. $f(x) = \begin{cases} \frac{1}{x} & агар \quad x \neq 0 \\ 3 & агар \quad x = 0 \end{cases}$




(0;3)) point for the function has a second round break which is the relative characteristic turning point.

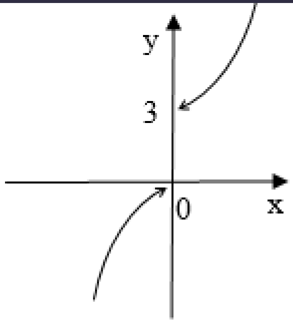
**5-example.** $f(x) = \begin{cases} -x^2 & агар \quad x < 0 \\ x^2 & агар \quad x > 0 \end{cases}$




Point function specificity for function which can be

Eliminated will be a unique turning point.

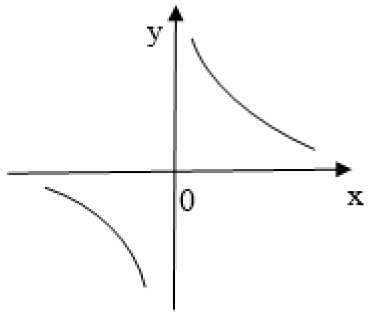
**6-example**. $f(x) = \begin{cases} -x^2 & агар \quad x < 0 \\ x^2 + 3 & агар \quad x > 0 \end{cases}$




$x = 0$ point is the first round for the function

An inconsistent turn with a break point will be

**7-example**. $f(x) = \frac{1}{x}$




$x = 0$ point for function second round an

Inconsistent turn with a break point

Will be

In the study of the turning points of a function graph, we believe that the naming of turning points, depending on whether the function is a breakpoint or a breakpoint of the function, is given in the textbooks with appropriate modifications.

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