List of definitions for Midterm 1

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1 $\lim_{x\to a} f(x) = L$ (limit of $f(x)$ as x approaches a is L)

Let f be a function defined on some open interval that contains the number a, except possibly at a itself. Then we say that the **limit of** $f(x)$ **as** x **approaches** a **is** L, and we write

$$\lim_{x\to a} f(x) = L$$

if for every number $\epsilon > 0$ there is a number $\delta > 0$ such that

$$\text{if} \qquad 0 < |x-a| < \delta \qquad \text{then} \qquad |f(x) - L| < \epsilon$$

2 $\lim_{x\to a} f(x) = \infty$

Let f be a function defined on some open interval that contains the number a, except possibly at a itself. Then

$$\lim_{x\to a} f(x) = \infty$$

means that for every positive number M there is a positive number δ such that

$$\text{if} \qquad 0 < |x-a| < \delta \qquad \text{then} \qquad f(x) > M$$

3 f continuous at a

A function f is **continuous at a number a** if

$$\lim_{x\to a} f(x) = f(a)$$

4 f continuous on an interval

A function f is **continuous on an interval** if it is continuous at every number in the interval (if f is defined only on one side of an endpoint on the interval, we understand *continuous* at the endpoint to mean *continuous from the right* or *continuous from the left*.)

5 $\lim_{x\to\infty} f(x) = L$

Let f be a function defined on some interval (a, ∞). Then

$$\lim_{x\to\infty} f(x) = L$$

means that for every $\epsilon > 0$ there is a corresponding number N such that

$$\text{if} \qquad x > N \qquad \text{then} \qquad |f(x) - L| < \epsilon$$

6 $\lim_{x\to\infty} f(x) = \infty$

Let f be a function defined on some interval (a, ∞). Then

$$\lim_{x\to\infty} f(x) = \infty$$

means that for every positive number M there is a corresponding number N such that

$$\text{if} \qquad x > N \qquad \text{then} \qquad f(x) > M$$

7 $f'(a)$ (derivative of f at a)

The **derivative of a function f at a number** a, denoted by $f'(a)$ is

$$f'(a) = \lim_{h\to 0} \frac{f(a+h) - f(a)}{h}$$

if this limit exists

8 f differentiable on a, f differentiable on (a, b)

A function f is **differentiable at** a if $f'(a)$ exists. It is **differentiable on an open interval** (a, b) [or (a, ∞) or $(-\infty, a)$ or $(-\infty, \infty)$ if it is differentiable at every number in the interval.

Test yourself!

Now, without looking at the definitions on the previous pages, try to define the following terms. Then compare your answers to the definitions above, and correct any mistake you make. You have to memorize those definitions **word by word**, e-mail me if you have any doubts about a definition!

1. $\lim_{x\to\infty} f(x) = \infty$
2. f differentiable at a, f differentiable on (a, b)
3. f continuous at a
4. $\lim_{x\to\infty} f(x) = L$
5. $\lim_{x\to a} f(x) = L$
6. Derivative of f at a
7. f continuous on an interval
8. $\lim_{x\to a} f(x) = \infty$