

Mathematics-Science 380 – History of Mathematics

Trent University, 2006–2007

Assignment #10

Due in the week of 12 March, 2007.

Neither Newton nor Leibniz provided a rigorous foundation for calculus. Each based his version of differential calculus on an intuitive notion, Newton on that of *fluxion* and Leibniz on that of *infinitesimal*.

1. What is a fluxion and, respectively, an infinitesimal? [1]
2. Describe Newton's notion of derivatives and the role of fluxions in it. [2]
3. Describe Leibniz's notion of derivatives and the role of infinitesimals in it. [3]
4. Describe (informally!) how the use of infinitesimals can be made rigorous. [4]

Apropos some of these questions, you may find H. Jerome Keisler's first-year calculus text *Elementary Calculus: An Approach Using Infinitesimals* to be of some interest. It is available for download under a Creative Commons license (Attribution-NonCommercial-ShareAlike 2.0) at <http://www.math.wisc.edu/~keisler/calc.html> .

There's a Delta For Every Epsilon (Calypso)

Words and Music by Tom Lehrer

There's a delta for every epsilon,
It's a fact that you can always count upon.
There's a delta for every epsilon
And now and again,
There's also an N .

But one condition I must give:
The epsilon must be positive
A lonely life all the others live,
In no theorem
A delta for them.

How sad, how cruel, how tragic,
How pitiful, and other adjectives
That I might mention.
The matter merits our attention.
If an epsilon is a hero,
Just because it is greater than zero,
It must be mighty discouragin'
To lie to the left of the origin.

This rank discrimination is not for us,
We must fight for an enlightened calculus,
Where epsilons all, both minus and plus,
Have deltas
To call their own.

There are in this world optimists who feel that any symbol that starts off with an integral sign must necessarily denote something that will have every property that they should like an integral to possess. This is of course quite annoying to us rigorous mathematicians; what is even more annoying is that by doing so they often come up with the right answer.

E. J. Mcshane

[The worst part is that way too many of these annoying people are physicists . . .]