Math 106—Calculus II Project 1
A bit of profligate consumption...

by Gavin LaRose (glarose@NebrWesleyan.edu), Nebraska Wesleyan University, January 1997

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Sophisticated Mathematical Contractors, Inc., a mathematical contracting firm located in bustling downtown Lonlinc, Skanebra, has recently hired you as contractors to facilitate its ability to compete with neighboring contracting firms. As luck would have it, this appears to have been a good call, as it preceded the acquisition of an exceedingly lucrative defense related contract from Hocklead-Tarmin, Inc. The contract from H-T, working on the development of a new Strategic Targeting Defense Fighter, has been assigned as your first.

Hocklead-Tarmin, Inc.

15000 Dalame Dr.
Verden, DO
28802-0540

24 January, 1997

Sophisticated Technical Contractors, Inc.
Suite 1, Strawmarket Business Plaza
Lonlinc, SK 04685

Dear STC:

As has been frequently reported by the media, Hocklead-Tarmin is a leader in the current competition to produce the next generation of strategic jet fighter for the U.S. military. In this capacity we are constantly evaluating the relationship between the the fuel consumption and attainable velocity of our jets, and it is to assist with this analysis that we have contracted with your company.

In particular, as you may suspect from your consulting experience, the force obtained from the engines used in one of the classes of fighters we are considering we have determined to be related to the rate at which its fuel is consumed, being $F_{jet} = \alpha(r(t))^{4/3}$. The constant α is determined by the fighter model in the class being considered and the drag force on the plane and $r(t)$ is the rate of fuel consumption as a function of time. This force accelerates the plane according to Newton's much heralded law ($F = ma$).

The function $r(t)$ is clearly dependent on the flight pattern of the plane, and we therefore need you to consider three possible cases for it: (1) when the rate is constant for the duration of the acceleration period; (2) when the rate is steadily decreasing for the duration of the acceleration period, and (3) when the rate is initially high and decreases at a decreasing rate as the plane accelerates. For each of these you should assume that the rate is initially 500 ffu (fighter fuel units)/min, and for each it is reasonable to suppose an acceleration period of ten minutes. In each case, we need you to determine—in terms of the characteristics of the fighter (m and α)—the maximum velocity attained by the jet.

As is our custom when contracting with outside companies, we have arranged for a local expert to be at your disposal should you have any questions regarding your work on the project. Accordingly, Dr. Gavin LaRose (an eccentric mathematician at a local university) will be available to field what questions you might have. You must in any event contact him with a report of at least preliminary work by the 31st of January, and with a more in depth report by or on the 13th of February. Your final 3–5 page typewritten report is due on the 17th of February. Any equations supporting your results may be hand-written in blank lines between your typewritten explanation you wish. Sample reports are also available for examination from Dr. LaRose.

Sincerely,

O. W. R. Eit III
CEO, Hocklead-Tarmin, Inc.

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