Math 105—Calculus I Project 2
constructing freedom, or something like that...

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After your resoundingly successful debut at IMC, Inc., the company is clearly eclipsing the number of contracts obtained in its first year of operation. The next contract you have been assigned comes from the famous Rocket Tech Division of Utoff A.F. Base, having to do, apparently, with the development of the new space station. The letter you received on the matter follows.

Rocket Tech Division
Utoff A.F. Base
1 Piecemeal Dr.
Haoma, SK
13681-0050

18 October, 1996

Independent Mathematical Contractors, Inc.
Suite 2, Strawmarket Business Plaza
Lonlinc, SK 04685

Dear IMC:

As you undoubtedly know, the National Space Agency (NSA) is in the process of developing a space station, to be built in orbit in the foreseeable future. After having in the last year capitalized on our success in the development and use of such defensive works as the Otpatri missile system to carefully assess the success of a system to protect the space station from space asteroids and debris, we are faced now with another aspect of the planning for the construction of the space station Omfreed.

In the course of the construction of the space station, it will be necessary to send manned and unmanned Extra-Vehicular Craft (EVC) between different units of the station being assembled. It is initially planned that these units be initially positioned some 500 feet apart. The EVC will move in a straight path between the units, and it is proposed that it move so that its distance from the first unit be given by one of the two formulas

$$d_1(t) = 30t(1 - e^{-.0458t}) - .339t^2 \quad \text{or}$$
$$d_2(t) = 20t(1 - e^{.02t}) + .887t^2,$$

where distances are in feet and time t in minutes. The thrust (force) generated by the engines of the EVC is given to be $T(r) = .15\, r^{8/3}$, where r is the rate at which its fuel is burned. As you also know, the great-great-grandfather of the space program, Isaac Newton, reported that the force on an object is proportional to its mass, m, times its acceleration, a.

We need from your company:

1. An analysis of the rate at which the fuel in the EVC is burned for the two movement proposals,
2. An analysis of where the maximum and minimum fuel consumption is taking place for each of d_1 and d_2,
3. An analysis of the total amount of fuel burned for both, and
4. Based on your answers to (1)–(3), a recommendation for which of d_1 or d_2 is the preferable movement proposal.

We must submit a the results of our investigation to the NSA by the 15th of November, and therefore need your finished report by the 13th of that month. To facilitate your work on the project, we have arranged that you be able to contact Dr. Gavin LaRose, a technical expert in many fields, with whom we have an affiliation. Please note that you should in any event contact him by the 25th of October with an indication of your initial work on the project and again by the 1st of November with further evidence of your progress. Failure to meet any of these deadlines will, of course, be grounds for reducing your payment.

We look forward to receiving your report, which should be typewritten and 3–5 pages in length. Equations explaining your solution should be included in the report, and it is permissible to hand-write these in blank lines between your typewritten explanation if this greatly facilitates the production of the report.

Sincerely,

Lieutenant General Rick N. Backer
Commander, Rocket Tech Division