Mathematics 134 -- Intensive Calculus for Science 2

Discussion 1 -- A Balloon Trip with the Montgolfier Brothers, Continued

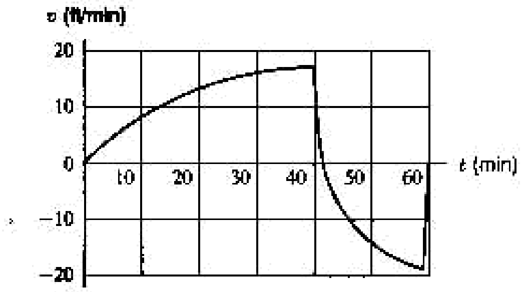
January 15, 2002

The Story

The Montgolfier brothers, Joseph and Etienne, were pioneers in hot-air ballooning in the late 1700's in France. If they had possessed appropriate instruments, they might have left a record of one of their early experiments as shown in the graph below. The graph shows the *vertical velocity v* of their balloon as a function of time *t*. Recall that we analyzed this trip in a discussion last semester and saw that

- The burner in the balloon apparently went out at $t = 40$
- The balloon was rising from $t=0$ to about $t = 42$, and falling between then and $t = 60$
- The balloon had positive acceleration from $t=0$ to $t = 40$, and again briefly just before $t = 60$.

Today, we want to use the same graph of the velocity to try to estimate the *total change in height* over the trip using the information in the graph.



Discussion Questions

1. What were the smallest and largest velocities of the balloon for t between $t = 0$ and $t = 10$? Use this information to give two estimates of the distance travelled on this interval -- one definitely smaller than the actual distance travelled, and one definitely larger.
2. Now do the same on the intervals
   - $t = 10$ to $t = 20$,
   - $t = 20$ to $t = 30$,
   - $t = 30$ to $t = 40$, and
   - $t = 40$ to $t = 42$.
3. Use the results of the previous questions to give two estimates of the maximum altitude the balloon reaches -- one definitely an overestimate and one definitely an underestimate. (How?)

4. Now, do the same for the downward portion of the trip -- give a definite overestimate and underestimate for the total change in altitude over the downward part of the trip.
5. Using your work on the previous questions, did the balloon end up higher, lower, or at the same height it started? How can you tell?
6. Suppose now you want to really convince someone (i.e. Prof. Little!) of your conclusion. Write up a paragraph explaining how you are using the information from the graph, justifying your reasoning and calculations, and showing that your conclusion in part 5 is correct.

Assignment

Group write-ups due in class no later than Monday, January 21.