M408R in-class problem, November 19, 2014

Last week the European Space Agency landed a lander, called Philae, on a comet 300 million miles from Earth. The trouble is that the lander had limited battery power, and a lot of scientific experiments to do. Philae made it through the primary to-do list before its battery went dead.

Suppose that Philae's last experiment requires 500 units of energy. However, the battery will only be capable of putting out $300e^{-t/2}$ units of energy per hour at a time t hours from now. Will Philae be able to complete its last task? If so, how long will it take?

That's a lot to think about, so let's break it down into steps.

a) How much energy does the battery put out in a time interval of length Δt?

b) Write down a Riemann sum that approximates the energy output between time a and time b.

c) By taking a limit as the number of time intervals goes to infinity, write down an integral that gives the energy output exactly.

d) Now let $A(t)$ be the energy output between time 0 and time t. Find a formula for $A(t)$.

e) Can you solve $A(t) = 500$? If so, what is t?