Good old chemistry...let’s go for the Nobel. (MUST DO)

With spring break just around the corner, Cornell freshman Yuka is very excited because she has bought tickets to the #1 college spring break destination, the beautiful party-hearty Bermuda triangle centre! (...or at least that’s what the sales rep. told her) Her friends couldn’t believe her, however, as the smart 293-AEW Student Yuka is, there’s a reason why she’s chosen such uncanny destination.

She knows that the spot is not as mysterious as people say it is and that most tragic “inexplicable” incidents in the area are due to odd variations in electromagnetic and gravitational fields occurring at the center, which she plans to use to her advantage. She’s after periodic table element 119, which she will call Asanostrium (her last name is Asano...go figure) and she knows that being there, the odd environment could allow her to control the half life of the sought-after element.

The first order chemical reaction she developed has the form:

\[ \frac{dA(t)}{dt} + 2kU(t) = -A(t) \quad A(t) = a \frac{dU(t)}{dt} - kU(t) \]

where \(A(t)\) is the resulting half-life of Asanostrium which depends on \(U(t)\), the amount of the previous element Ununoctium needed in the reaction. \(a\) and \(k\) are positive constants given by the strength of the electromagnetic and gravitational fields respectively.

The problem is that the procedure of creating Asanostrium is not straightforward, since it heavily depends on the amount of Ununoctium, and there’s not that much of it available. (This means that she can’t afford to have \(B(t)\) be in the form of exponential growth or decay)

a) Where on the center of the Bermuda triangle must she go to have a chance to win the noble prize? –assuming that the discovery is worthy of such reward.
(Hint: Find the conditions on the electromagnetic and gravitational field necessary to conduct the reaction)

b) Set up the differential equation to find \(A(t)\) … if its not too difficult to solve we might have to call the patents office.