Homework #18
Back to the Future
GROUP WORK OKAY, Due 3/28/23 at beginning of class
(Don't be afraid to "Google" good assumptions!)

Back to the Future
(WARNING – Strong language in last half of the YouTube clip; don't watch past 1:10!)

The flux capacitor is the single greatest invention of our time, but the energy requirements are incredible! 1.21 GW? Seriously? Luckily Doc brown had a few jars of plutonium (water shielded of course). Assuming that the water/plutonium ratio in the jar (on the clip) is the same ratio as in the reactor, determine whether there is sufficient plutonium (assume it's pure ^{239}Pu) for the reactor to be critical. Also, determine the power of such a critical reactor, assuming a max thermal flux of 2×10^{16} neut/cm^2/s.

1) What is this problem actually asking for? (Be specific, and answer in terms of things you can actually solve for!)

2) Draw a sketch depicting the conditions of interest, including variables that need to be considered when simplifying this problem.

3) a) What physical laws apply to this problem?
b) Indicate equations, correlations, and/or formulae that can model these laws.
c) What are the potential limitations of these equations?

4) What assumptions should be made?
a) List ALL the assumptions that you need to in order to solve the problem.
b) Justify your assumptions (references, reasoning, judgment, common sense, etc. where possible, use numbers and ***quick*** calculations)

5) What are the physical properties you used in this problem?

6) Calculate the quantity that you listed in part 1 (be sure to include intermediate values).

7) Verify your answer... Does it look reasonable? Anything odd about the calculation?
a) How much plutonium is needed for the reactor to be exactly critical?
b) Does this reactor ***need*** to be critical? Why/Why not?
c) What is the actual multiplication factor for this reactor?
d) Is there a better arrangement for the fuel to create the power than a rod?