Open Ended Problem #10
The Avengers
INDIVIDUAL WORK ONLY, Due 12/6/24 at beginning of class
(Don't be afraid to "Google" good assumptions!)

The Avengers

In a thematic scene of pure awesome, the Avengers stop Loki and his army of Chitauri from conquering earth though a wormhole opened by the Tesseract (we won't go into the inaccuracies of the nuke and the blast in the Chitauri mother-ship… in this class) successfully closing the portal and saving the earth from alien invaders (how cliché). However, there is a serious problem with this scene. Although mass is supposed to be moving through the portal, no air is going through the wormhole, which it would be if a wormhole were opened in the atmosphere of earth! Given this, calculate the rate at which air passes through the portal when it is first opened. Does earth survive Loki, only to be suffocated by the open portal into space?

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) Produce a plot of the flow rate as a function of earth's atmospheric pressure. Based on this, what is the pressure at which the flow through the portal is no longer choked?

b) Produce a plot that illustrates the flow rate through the portal as a function of time. How long until air stops flowing through the portal?

c) Could the avengers have closed the portal before everyone on the planet suffocated?