Open Ended Problem #5
Exploding Trains and 88 mph
GROUP WORK OKAY, Due 10/16/24 at beginning of class
(Don't be afraid to "Google" good assumptions!)

Back to the Future 3 Clip

Great Scott!!! Reaching 88 mph is crucial to time travel, as the Brilliant Doc Brown discovered. However, back in 1885, the only means he had of accelerating his DeLorian time machine was to use a steam engine locomotive. In order to make sure that this would work (since if it didn't they'd be in for a long free fall into a deep ravine), he decided to build a scale model, primarily to ensure that the drag forces on the train wouldn't preclude reaching 88 mph. How fast should the model train be moving in order to ensure similarity between the model and the actual attempt at reaching 88 mph?

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.

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) It turns out that at 72 mph, the drag forces balance out the force of the steam engine, meaning no further acceleration was possible. To fix this problem, Doc Brown created exploding logs to create higher temperature, pressure, and thus "CONSTANT" acceleration in the steam engine. How much acceleration did the log need to provide in order to overcome the drag forces and bring the DeLorian to 88 mph?
b) Could this burst of acceleration really have broken the rod that Clara was holding on to? Could Doc Brown have maintained his hold?
c) It is 3 miles from the location of the DeLorian (at 0 mph initially) to the ravine. Is this enough distance to enable reaching 88 mph, based on your analysis?