

Open Ended Problem #7

The Return of the King

Group work okay, Due 11/1/23 at beginning of class

(Don't be afraid to "Google" for reasonable assumptions; just provide references!)

Flame of the West

Andúril was pivotal in the defeat of Sauron, owing to the fact that Aragorn use it to both summon an undead army, as well as to defeat hordes of orcs, goblins, and even trolls. Even more notable, Andúril was a sword reforged from the shards of Narsil, the blade that originally cut the one ring from Sauron's hand. The challenge, however, is the method of such a reforging. It required the best of elven smiths to complete this work. You, as material scientists, have the knowledge to direct the elven team in creating Andúril. For this problem, there are 3 things you must provide: 1) a description of the physics that play into reforging a broken blade on an atomic, crystalline, microstructure, and macrostructure level, 2) a specific description of HOW this process can be conducted (i.e. the steps required to do this), and 3) the final composition, microstructures, and mechanical properties of the newly forged Andúril. Keep in mind that it must be both ductile and strong to fully work as a sword.

- 1) What is this problem actually asking for? What is the final value you are being asked to find?
- 2) Draw sketches or plots that indicate the actual problem and the spider silk properties 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 to utilize the equations/correlations/formulae listed in part 3b?
 - 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.)
- 5) What are the physical properties (list assumed or referenced values) used in this problem?
- 6) What are the physics, processes, and properties associated with the newly reforged Andúril?
- 7) Verify your answer... Does it look reasonable? Anything odd about the calculation?
 - a) If you chose a different path for reforging this sword, how drastically do the properties change?
 - b) What would happen if this blade was forged to be too ductile?
 - c) What would happen if this blade was forged to be too brittle?
 - d) Based upon your answer in 6, how large of an impact force would break Andúril if it had the composition you listed?