

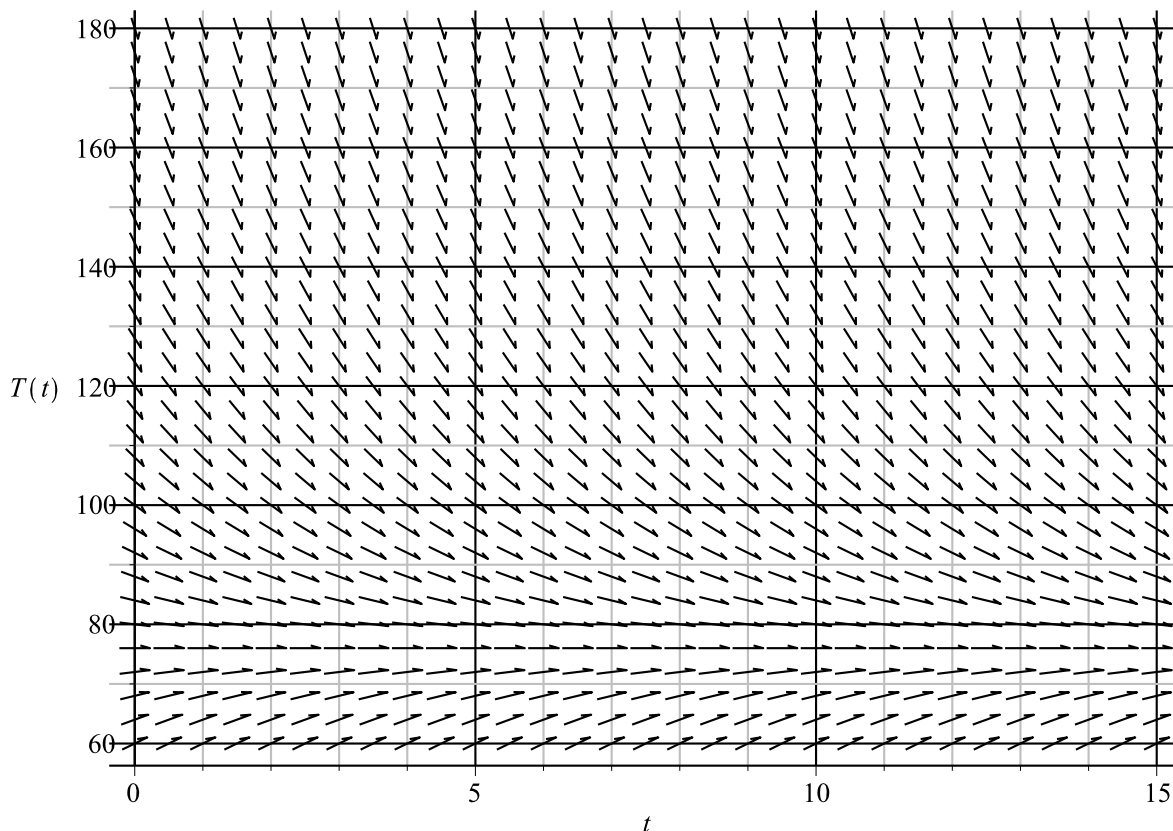
Show all work, including mental steps, in a clearly organized way that speaks for itself. Use proper mathematical notation, identifying expressions by their proper symbols (introducing them if necessary), and use equal signs and arrows when appropriate. Always SIMPLIFY expressions. BOX final short answers. LABEL parts of problem. Keep answers EXACT (but give decimal approximations for interpretation). Indicate where technology is used and what type (Maple, GC). [Recall you need $y'(t)$, $y(t)$ instead of y' , y in your differential equation for an unknown variable y for Maple to interpret the prime as a t derivative.]

1. $\frac{dT}{dt} = -k(T - A)$

a) A pot of liquid is put on the stove to boil. The temperature of the liquid reaches 170 degrees F and then the pot is taken off the burner and placed on a counter in the kitchen. The temperature of the air in the kitchen is 76 degrees F. After two minutes the temperature of the liquid in the pot is 123 degrees F. How long before the temperature of the liquid in the pot will be 84 degrees F? Assume this liquid obeys Newton's law of cooling. [Use the linear solution technique to solve this DE. Show every step of the process clearly. Answer this word problem with a complete English sentence which can be directly compared to a clock. Box it. During the process keep things exact and don't introduce any decimal points long enough for you reach an exact value for τ requested below. Use common sense about the number of significant digits you give the final answer.]

b) Using the slope field below, locate the initial data point and the secondary data point by circled dots. Then make a rough hand sketch of your solution, labeling on your sketch the initial and secondary data points given above. Is your hand drawn curve consistent with your answer to the question posed in part a) as well as the secondary information? Explain.

c) What is the exact value of the corresponding characteristic time τ (with units) for this exponential decay problem and its numerical value to 3 significant digits? How long does it take the temperature difference to drop to 5 percent of its initial value? How many characteristic times does this represent? Support your answer with a calculation.



2. $\frac{dy}{dx} = \frac{2-x}{y-1}$, $y(0) = 0$

- a) Solve this initial value problem (IVP) with Maple and write down the solution.
- b) Find the general solution for $y(x)$.
- c) Find the solution which satisfies the initial condition.
- d) What is the domain of this solution (i.e., for what range of x is it defined)?
- e) Check that your IVP solution of the DE is correct by substitution and simplification.
- f) Draw a rough diagram of your solution of the IVP, labeling everything about the curve which is relevant to its interpretation.

Be sure to sign and date the pledge before handing in this test.

► solution

▼ pledge

When you have completed the exam, please read and sign the dr bob integrity pledge and hand this test sheet in on top of your answer sheets as a cover page, with the first test page facing up:
"During this examination, all work has been my own. I give my word that I have not resorted to any ethically questionable means of improving my grade or anyone else's on this examination and that I have not discussed this exam with anyone other than my instructor, nor will I until after the exam period is terminated for all participants.
"

Signature:

Date: