Midterm II Take Home Question, Autumn 2023

You can work with classmates on these (in fact, I encourage it), but nobody else.

Work this problem out and create a PDF file. If you're not working electronically already, there are apps for both iOS and Android that will turn a smartphone photo into a pdf file, even natively. **Whatever format, please make sure that it is legible.** You will need to upload it to Carmen/Canvas on the day the exam is scheduled on the syllabus.

1.) (*20 points*) If we have the recursive relation $T(n) = 3T(n/7) + Cn$ for $n > 1$ (with base case $T(1)$ a constant) defining[1] a function $T(n)$ then there is some function in the Θ-set hierarchy, $g(n)$, which makes $T(n) \in \Theta(g(n))$ true. Use either expansion into a series or the recursion tree method to determine (a.k.a. guess) what that function is. Include your work.

Do <u>NOT</u> do the proof by substitution!

---

[1]As an aside, it is worth noting that the recursive relation is really something more like

$$T(n) = 5T\left(\left\lfloor \frac{n}{8} \right\rfloor\right) + Cn$$

since T is supposed to be a function defined on the non-zero natural numbers.