Note about Master Theorem...

Even our advanced Master Theorem does not have all the answers for all Divide & Conquer recurrence relations.

Consider $T(n) = 2T(n/2) + \underbrace{n \lg n}_{f(n)}$ $\quad \log_2 2 = 1$

$$n \lg n \overset{?}{\in} \begin{matrix} O(n^{1-\varepsilon}) \\ \Theta(n) \\ \Omega(n^{1+\varepsilon}) \end{matrix}$$

$n \lg n$ is not in any of these categories

We can see that more clearly if we divide $n \lg n$ and whats in the O, Θ, Ω by n (yes, we can do that)

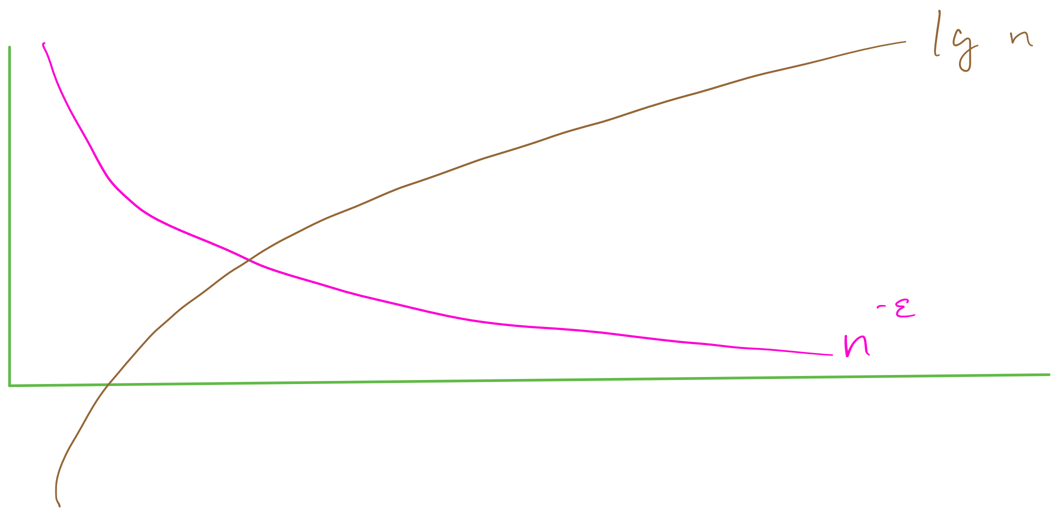
Then the question becomes:

for positive ε

$$\lg n \overset{?}{\in} \begin{matrix} O(n^{-\varepsilon}) \\ \Theta(1) \\ \Omega(n^{\varepsilon}) \end{matrix}$$

we know $\lg n$ is not in these classes.

$n^{-\varepsilon}$ is actually a <u>decreasing</u> function, whereas $\lg n$ is an increasing function, so clearly $\lg n \notin O(n^{-\varepsilon})$ for any positive ε.



$\therefore$ The master Theorem is SILENT on this recurrence.

That's the answer you give on a test or assignment.