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Questions for 17/12/2022

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Q1 - Show that the sequence $a_n = (1 + 1/n)^n$ is a monotone increasing sequence and is bounded above. We call its limit as e.

Q2 - Repeat the same for sequence x_n = 1 + 1/1! + 1/2! + 1/3! … + 1/n!. And show that limit = e (same as above)

Q3 - Show that the sequence $a_n = (1 + \frac{1}{n})^{n+1}$ is a monotone decreasing. Also find its limit. (limit = e)

Q4 - u_n = 1 + 1/2 .. + 1/n - logn; v_n = 1 + 1/2 … + 1/(n-1) - logn, n≥2. Show that u_n is a monotone decreasing sequence and $(v_n)_{n=2}^{\infty}$ is an monotone increasing one and they converge to same limit.

Q5 - If u1 > 0 and u_{n+1} = 1/2($u_n + 9/u_n$) for n ≥ 1. Prove that the sequence converges to 3.

Q6 - For a,b $\in \mathcal{N}$, consider the sequence (shown below), for n > a,b. Which of the following statements are true? As n $\to \infty$

$$d_n = \frac{\binom{n}{a}}{\binom{n}{b}}$$

a. d_n converges for all values of a and b

b. converges if a<b

c. converges if a = b

d. converges if a>b

Q7 - A function $f : \mathcal{R}$ is defined by f(x) = x if x $\in \mathcal{Q}$ or = 0 if x $\in \mathcal{R} - \mathcal{Q}$. Show that f is continous at 0 and f has a discountinuity of the second kind at every other point in $\mathcal{R}$. ($\mathcal{Q}$ is Rational set)

Q8 - A function $f : [0,1] \to \mathcal{R}$ is continuous on $[0,1]$ and assume it takes rational values. If $f(1/2) = 1/2$, prove that $f(x) = 1/2$ for all $x \in [0,1]$.