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$$L(x) := \sum_{n=1}^{\infty} \frac{f_n(x)}{2^n c_n}$$

is a smooth function having the required properties. In particular, as for any  $n \geq 1$  the differential  $df_n$  vanishes on  $A_n \cup A_n^*$ , the differential of  $L$  vanishes on  $R$ .  $\square$

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