

Q3: Suppose that there is some Lebesgue measurable set E that satisfies the hypothesis. Let $I = [0, a)$. We cover $E \cap I$ with a disjoint collection of sets $\{F_i\}$. We have that

$$\frac{a}{2} = m(E \cap I) \leq m\left(\bigcup_i F_i\right) \leq a,$$

Since the covering $\{F_i\}$ cover $[0, a]$. Therefore we have that $a = 0$ and thus $m(E) = 0$, which contradicts our assumption.