Problem #8. Dirichlet’s approximation theorem implies that for any irrational number $\alpha$ there are an infinite number of integers $p$ and $q$ so that
\[ |\alpha - \frac{p}{q}| < \frac{1}{q^2}. \]

a) Show that the set of rational numbers $p/q$ where $p$ and $q$ are as above is infinite.
b) Using the above fact and the fact that $|\sin x| \leq |x|$, show that 0 is a limit point of the sequence $\{\sin n\}$.
   (Hint: $\sin(m\pi) = 0$ for $m \in \mathbb{Z}$).