1. Define a function $f : \mathbb{R} \to \mathbb{R}$ by

$$f(x) = \begin{cases} 
  x & \text{if } x \in \mathbb{Q} \\
  0 & \text{if } x \notin \mathbb{Q}
\end{cases}$$

Prove that $f$ is continuous at 0, but has a non-jump discontinuity at all nonzero points of $\mathbb{R}$.

2. Exercise 14, p. 100 in Rudin.

3. Exercise 15, p. 100 in Rudin.

4. Exercise 19, p. 100 in Rudin.