Theorem 1: If the sequence $p_1, p_2, p_3, ...$ converges to the point x and y is a point different from x, then $p_1, p_2, p_3, ...$ does not converge to y.

Proof. Let $p_n = p_1, p_2, p_3, ...$ be a sequence that converges to the point x and let y be a point different from x. Let $\epsilon > 0$, $\epsilon = \frac{|x-y|}{2}$. Let $U = (x-\epsilon, x+\epsilon)$ be an open interval containing x and $y \notin U$. Since p_n converges to x, $\exists N \in \mathbb{Z}^+$ such that $\forall n \in \mathbb{Z}^+$, $n \geq N$, $p_n \in U$. Now pick $\delta > 0$ so small that $V = (y-\delta, y+\delta)$ that has an empty intersection with U.
$\therefore$ Since $V \cap U = \oslash$, p_n does not converge to y because $\forall n \in \mathbb{Z}^+$, $n \geq N$, $p_n \in U$, $p_n \notin V$. $\square$