Exercise 7 solution:

(a) Suppose there exist integers p, q and a real x satisfying $F^q(x) = x + p$. Then $f^q\pi(x) = \pi F^q(x) = \pi(x + p) = \pi(x)$, so that $\pi(x)$ is a periodic point of period q for f.

(b) Suppose $f^q(\theta) = \theta$ for some $\theta \in \mathbf{T}$. Let $\pi(x) = \theta$. Then $\pi(x) = f^q\pi(x) = \pi F^q(x)$, so $F^q(x) = x + p$ for some integer p. Let $\pi(y) = \theta$. Then $y = x + k$ for some integer k, and $F^q(y) = F^q(x + k) = F^q(x) + k = x + p + k = y + p$. Hence there exists an integer p such that $F^q(x) = x + p$ for all $x \in \pi^{-1}(\theta)$.