For any finite set A and full relation R on A, there is a Hamilton path in R.
Proof: We must show the for any finite set A and full relation R on A, then there exists a Hamilton path in R. Suppose A is an arbitrary set, $|A| = k$, and R is a full relation on A. We must show there exists a Hamilton path in R. By definition of a Hamilton path, we must show that there is a non-repeating R-path through every element in A. Assume for contradiction that the longest R-path does not include every element in A. Let $(a_1, \cdots, a_t)$ be the longest R-path, where $t < k$. Therefore exists an element $a^* \in A$ such that $a^* \notin (a_1, \cdots, a_t)$. Since R is full, then there exists 4 cases of how a^* relates to a_1 and a_t:

- $a^* R a_1$, $a^* R a_t$
  Since $a^* R a_1$, a^* can be appended onto the beginning of $(a_1, \cdots, a_t)$ and form a valid R-path, contradicting our previous assumption.

- $a^* R a_1$, $a_t R a^*$
  Since $a^* R a_1$, a^* can be appended onto the beginning of $(a_1, \cdots, a_t)$ and form a valid R-path, contradicting our previous assumption.

- $a_1 R a^*$, $a_t R a^*$
  Since $a_t R a^*$, a^* can be appended onto the end of $(a_1, \cdots, a_t)$ and form a valid R-path, contradicting our previous assumption.

- $a_1 R a^*$, $a^* R a_t$
  Since these two relations don't provide a clear insertion point for a^*, then we must look at the orbit of a^*: $O^* = \{a \in A : a^* R a\}$. Since $a_1 R a^*$, we have at least one element that is in O^{*c}. Since the relation is full by definition $A = O^* + O^{*c}$. Therefore since there exists elements of both O^* and O^{*c} that lie in $(a_1, \cdots, a_t)$, then there must exists an element in O^{*c} next to an element from O^*. Suppose the element from O^{*c} occurs at index i. Therefore since $a_i R a^*$ and $a^* R a_i$, then a^* may be inserted at i, forming a valid R-path.

Therefore since all of the cases result in a contradiction, then $t = k$, and R has a Hamilton path.