Let $G = \langle g \rangle$ be cyclic of order $n > 1$.

(a) $|G \times G| = |G| \times |G| = n \times n = n^2$.

(b) If $(a,b) \in G \times G$ then $a = g^i$ and $b = g^j$ for some $0 \leq i,j \leq n$. Hence

$$(a,b)^n = ((g^i)^n, (g^j)^n) = ((g^n)^i, (g^n)^j)$$
$$= (e^i, e^j)$$
$$= (e, e) \quad \text{as } g \text{ has order } n.$$

(c) From (b), every element of $G \times G$ has order at most n. Since $n > 1$, it follows that $n^2 > n$, so no element has order n^2. From this, we see that

$G \times G$ cannot be cyclic, as it doesn't contain an element of order n^2 (the order of the group), which would contradict Proposition 4.14.