1. Prove that the semidirect product of H and K with respect to φ

   (a) Is a group of order $|H||K|$

   (b) Has subgroups isomorphic to H and K, where

      i. H is normal

      ii. $H \cap K = 1$, and

      iii. For all $h \in H$ and $k \in K$ we have $khk^{-1} = k \cdot h = \varphi(k)(h)$.

2. Classify all groups of order 12, up to isomorphism.

3. Let R be a principal ideal domain, and S a subset closed under multiplication. Show that $S^{-1}R := \{s^-1a : s \in S,\ a \in R\}$ is a principal ideal domain.