Problem 1: Let $\phi : G \to \overline{G}$ be a homomorphism with kernel $N$. If $K \leq G$, show that $\phi^{-1}(\phi(K)) = KN$. Use this to find an “if and only if” condition such that $\phi^{-1}(\phi(K)) = K$.

Problem 2: Suppose that $G$ is a group with a subgroup $H$ and a normal subgroup $N$. Show that $H \cap N \lhd H$.

Problem 3: Let $G$ be a group with normal subgroups $H, K$ such that $K \leq H$.

(a) Show that $K \lhd H$.

(b) Show that $H/K \lhd G/K$. 
