Exercises 8: 43, 47, 49

Exercises 9: 29, 33, 34, 36

Exercises 13: 2, 16, 17, 50

Additional exercises:

1. Let $\phi : G \to G'$ be a homomorphism. Prove each of the following statements.
   (a) If H is a subgroup of G, then $\phi(H)$ is a subgroup of G'.
   (b) If K is a subgroup of G', then $\phi^{-1}(K)$ is a subgroup of G. Recall that $\phi^{-1}(K) = \{g \in G \mid \phi(g) \in K\}$ is the *preimage* of K.
   (c) The map ϕ is injective if and only if $\ker(\phi) = \{e_G\}$.
2. Find the centralizer of the element $(1\ 2\ 3)$ in S_5. (Hint: $|C_{S_5}((1\ 2\ 3))| = 6$.)
3. Let G be a group and $S \subseteq G$ be a subset of G. Prove that for any $g \in G$, $gN_G(S)g^{-1} = N_G(gSg^{-1})$. Recall that $gSg^{-1} = \{gsg^{-1} \mid s \in S\}$. Hint: Given two sets A and B, to prove that $A = B$ you can prove that $A \subseteq B$ and $B \subseteq A$. (Note that since $C_G(S) \leq N_G(S)$, this implies that $gC_G(S)g^{-1} = C_G(gSg^{-1})$, as well.)