Solution to EP1:
(We will prove this by contrapositive.)
Suppose \([H : H \cap K]\) is not finite. Then we can write
\[
H = \bigcup_{n=1}^{\infty} h_n(H \cap K),
\]
where \(h_1 = e\) and \(h_i(H \cap K) \cap h_j(H \cap K) = \emptyset\) whenever \(i \neq j\). Now we note that each \(h_i \in H\), so \(h_i \notin K\) for every \(i > 1\). \textbf{WHY}?
Now consider
\[
\bigcup_{n=1}^{\infty} h_nK,
\]
and suppose that \(h_iK = h_jK\) for some \(i, j\). Now show that \(h_i = h_j\), which essentially concludes the proof. \textbf{WHY}?