1. $\forall a, b, ab \in G. \quad a = a^{-1}. \; b = b^{-1}$

$\Rightarrow (ab)^2 = (ab)(ab) = (ab)(a^{-1}b^{-1}) = e$

$\Rightarrow ab = (a^{-1}b^{-1})^{-1} = ba$

2. $\left(H \text{ is a subgroup}\right) \overset{\text{iff}}{\Longleftrightarrow} \left(e \in H \;\&\; h_1, h_2 \in H \Rightarrow h_1 h_2^{-1} \in H\right)$

$\Rightarrow$ trivial by def. of (subgroup.

$\Leftarrow \quad e, h \in H. \Rightarrow e \cdot h^{-1} = h^{-1} \in H$ (exists inverse)

$h_1 \cdot h_2 \in H. \Rightarrow h_2^{-1} \in H. \Rightarrow h_1 (h_2^{-1})^{-1} = h_1 h_2 \in H.$

(closure)

3. see P15 of Greg Moore notes [GM].