Q6i: We claim that $G' \trianglelefteq G$. Any element of G' must be of the form $b = ghg^{-1}h^{-1}$. We claim that for any $a \in G$, $aba^{-1} \in G'$. Observe:

$$aba^{-1} = aghg^{-1}h^{-1}a = ageheg^{-1}eh^{-1}a^{-1} = (aga^{-1})(aha^{-1})(ag^{-1}a^{-1})(ah^{-1}a^{-1})$$

We notice that this in the desired form, since the first and third terms are inverses of eachother, and the second and fourth terms are inverses of eachother. We conclude that $G' \trianglelefteq G$

Q6ii: We claim that G/G' is an abelian group. It is equivalent to show that for any $a, b \in G$,

$$abG' = baG' \iff ab(ba)^{-1}G' = G' \iff aba^{-1}b^{-1}G' = G'$$

The last equality is clearly true since $aba^{-1}b^{-1} \in G$.

Q6iii: Let $N \trianglelefteq G$ be such that G/N is abelian. We claim that $G' \subseteq N$. Let $a \in G'$. It must take the form $a = ghg^{-1}h^{-1}$ for some $g, h \in G$. We evaluate that

$$\begin{aligned}
aN &= (ghg^{-1}h^{-1})N \\
&= (gN)(hN)(g^{-1}N)(h^{-1}N) \\
&= (gN)(g^{-1}N)(hN)(h^{-1}N) \\
&= (gg^{-1})N(hh^{-1}N) \\
&= (eN)(eN) \\
&= eeN \\
&= eN \\
&= N
\end{aligned}$$

Therefore we have that $a \in N$ and we conclude that $G' \subset N$