Algebra Tutorial-V

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1. If H and K are finite subgroups of a group G, show that
$$|HK| = \frac{|H||K|}{|H \cap K|}.$$

2. If H is a subgroup of G and N is a normal subgroup of G, prove that $H/(H \cap N)$ is isomorphic to HN/N.

3. If H and K are normal subgroups of G and $H \leq K$, prove that $(G/H)/(K/H)$ is isomorphic to G/K.

4. (From Stackexchange:) Using second isomorphism theorem, show that
$$\gcd(a, b)\,\mathrm{lcm}(a, b) = ab.$$