Lagrange's Theorem Encyclopedia Article

Lagrange's Theorem

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Lagrange's Theorem

Lagrange's **theorem** is one of the fundamental theorems of finite **group theory**. Formally stated, the order of a subgroup of a group divides the order of the original group. This means that the number of elements in any subgroup of a finite group must divide evenly into the number of elements in the group. This would mean that a group with 50 elements could not have a subgroup of 8 elements since 8 does not divide 45 evenly. The subgroup could have 2, 5, 10, or 25 elements since these numbers are all divisors of 50. This theorem is also referred to as Lagrange's group theorem or sometimes Lagrange's lemma. The converse of Lagrange's theorem is not generally true.

In the 1770s Joseph Louis Lagrange, one of the greatest mathematicians on the 18th century, formulated the theorem named in his honor. He was one of the first mathematicians to study group structure. Lagrange, who was prolific in his career studying **mathematics and physics**, had a special talent for **number theory** and developed several theories dealing with numbers and their relations. Lagrange's theorem is just one of his many theories concentrated on number theory and more specifically group theory.

The converse of Lagrange's theorem is an interesting question in group theory. In general the converse of Lagrange's theorem is not true; that is that if a number n is a divisor of the order of a group that the group must have a subgroup of order n. There are however special cases where this is true. These cases are the focus of Sylow theorems.