

From the theorem of Pythagoras to variational principles in physics and geometry

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Variational principles play a fundamental role both in physics and in geometry. In the first case such principles are used to formulate the basic covariant field equations and to draw conclusions from inherent symmetries via Emmy Noether's theorem. In Geometry variational methods are employed to establish the existence of solutions to difficult problems. In fact, the problems of minimizing length and area were the first fundamental tasks in geometry where mathematicians studied and developed variational tools. In order to avoid technical complications we shall study some "elementary" problems which reflect the basic difficulties but can be solved without the machinery of analysis, e.g. Steiner's (Fermat's) problem and Schwarz's triangle problem.