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This setion is one of the most important sections in terms of widespread applications everywhere in the textbook. The Chain Rule is often a tool used to extend properties from the one variable calculus to multivariate and vector calculus. Often a function from $\mathbb{R}^n$ to $\mathbb{R}$ is coupled with another function from $\mathbb{R}$ into $\mathbb{R}^n$ to create a function from $\mathbb{R}$ to $\mathbb{R}$, then technique of differentiation from in one variable calculus is applied. Theorem 2.26 (Chain Rule I) is the main theorem about the Chain Rule and theorems 2.29 and 2.86 are important variations of it.

Here is a list of places where the Chain Rule was used in our textbook:

- 2.3: 2.37, corollary 2.38
- 2.4: proof of 2.39 (the Mean Value Theorem)
- 2.5: examples 1-3
- 2.6: proof of theorem 2.46
- 2.7: proof of Taylor's theorem (2.63) as well as argument toward the development of Taylor's formula, Lemma 2.76
- 2.8: proof of Proposition 2.78
- 2.9: the argument on top of page 103 leading to the design of the main formula for the method of Lagrange multiplier.
- 2.10: Chain rule III
- 3.1: proof of the IFT (3.1)
- 3.4: proof of the Inverse Mapping Theorem, theorem 3.18)
- 4.1: Fundamental Theorem of Calculus and its applications
- 4.4: the main technique of Change of Variable for multiple integrals.
- 4.5: this section is defining new functions based on old functions and on the technique of integration. So any property of composition functions is checked via the Chain Rule. In particular see (the important) examples 2 and 3.
- 5.1: formula for arc length (page 214) and the geometric interpretation at the bottom of page 217
- 5.4: proofs pf equalities in the middle of page 237
- 5.8: proof of theorems 5.60 and 5.62.