(1) Why is it that if you want to show that every perfect set is in one-to-one correspondence with \([0,1]\), then it is sufficient to prove that every nowhere dense perfect set is in one-to-one correspondence with \([0,1]\)?

(2) Explain Cantor’s construction of a non-constant, monotonic, differentiable function with derivative equal to 0 almost everywhere. Explain why the existence of this function demonstrates that Harnack’s extension of Theorem III cannot be valid.

(3) Explain Sheefer’s construction of a non-constant, monotonic, differentiable function with derivative equal to 0 almost everywhere.

(4) Harnack attempted to extend the definition of the integral to include the integral of any unbounded function \(f\) for which there is a discrete set, \(U_f\), such that \(f\) is bounded on the complement of any union of open sets that cover \(U_f\). What was wrong with his extension?

(5) Prove the equivalence of the definitions of absolute continuity given in equation (12) and footnote 11.

(6) Prove that a function has bounded variation if and only if it is the difference of two nondecreasing functions.