

TABLE PT6.3 Specific study objectives for Part Six.

1. Understand the derivation of the Newton-Cotes formulas; know how to derive the trapezoidal rule and how to set up the derivation of both of Simpson's rules; recognize that the trapezoidal and Simpson's $1/3$ and $3/8$ rules represent the areas under first-, second-, and third-order polynomials, respectively.
 2. Know the formulas and error equations for (a) the trapezoidal rule, (b) the multiple-application trapezoidal rule, (c) Simpson's $1/3$ rule, (d) Simpson's $3/8$ rule, and (e) the multiple-application Simpson's rule. Be able to choose the "best" among these formulas for any particular problem context.
 3. Recognize that Simpson's $1/3$ rule is fourth-order accurate even though it is based on only three points; realize that all the even-segment-odd-point Newton-Cotes formulas have similar enhanced accuracy.
 4. Know how to evaluate the integral and derivative of unequally spaced data.
 5. Recognize the difference between open and closed integration formulas.
 6. Understand the theoretical basis of Richardson extrapolation and how it is applied in the Romberg integration algorithm and for numerical differentiation.
 7. Understand the fundamental difference between Newton-Cotes and Gauss quadrature formulas.
 8. Recognize why both Romberg integration and Gauss quadrature have utility when integrating equations (as opposed to tabular or discrete data).
 9. Know how open integration formulas are employed to evaluate improper integrals.
 10. Understand the application of high-accuracy numerical-differentiation formulas.
 11. Know how to differentiate unequally spaced data.
 12. Recognize the differing effects of data error on the processes of numerical integration and differentiation.
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