

contentsline {section}{numberline {1}}Foundations: Probability and Statistics}{3}{section.1}%
 contentsline {subsection}{numberline {1.1}}The Random Walk and Binomial Distribution}{3}
 {subsection.1.1}% contentsline {subsection}{numberline {1.2}}Moments of a Distribution}{3}
 {subsection.1.2}% contentsline {subsection}{numberline {1.3}}Gaussian Approximation (Large N Limit)}
 {3}{subsection.1.3}% contentsline {subsection}{numberline {1.4}}Multivariable Probability and Change
 of Variables}{4}{subsection.1.4}% contentsline {section}{numberline {2}}The Statistical Basis of
 Thermodynamics}{4}{section.2}% contentsline {subsection}{numberline {2.1}}Microstates and
 Macrostates}{4}{subsection.2.1}% contentsline {subsection}{numberline {2.2}}The Fundamental
 Postulate}{5}{subsection.2.2}% contentsline {subsection}{numberline {2.3}}Statistical Definition of
 Macroscopic Parameters}{5}{subsection.2.3}% contentsline {subsection}{numberline {2.4}}Density of
 States}{5}{subsection.2.4}% contentsline {section}{numberline {3}}Interaction Between Systems and
 Laws of Thermodynamics}{5}{section.3}% contentsline {subsection}{numberline {3.1}}Types of
 Interaction: Heat and Work}{6}{subsection.3.1}% contentsline {subsection}{numberline {3.2}}The First
 Law of Thermodynamics}{6}{subsection.3.2}% contentsline {subsection}{numberline {3.3}}Quasistatic
 Processes and Generalized Forces}{6}{subsection.3.3}% contentsline {subsection}{numberline {3.4}}
 Thermal Equilibrium, Entropy, and Temperature}{7}{subsection.3.4}% contentsline {subsection}
 {numberline {3.5}}The Second Law of Thermodynamics}{7}{subsection.3.5}% contentsline {subsection}
 {numberline {3.6}}The Fundamental Thermodynamic Relation}{7}{subsection.3.6}% contentsline
 {subsection}{numberline {3.7}}Summary of Thermodynamic Laws}{8}{subsection.3.7}% contentsline
 {section}{numberline {4}}Thermodynamic Response Functions}{8}{section.4}% contentsline
 {subsection}{numberline {4.1}}Heat Capacities}{8}{subsection.4.1}% contentsline {subsection}
 {numberline {4.2}}Compressibility and Expansivity}{9}{subsection.4.2}% contentsline {section}
 {numberline {5}}Application: The Ideal Gas}{9}{section.5}% contentsline {subsection}{numberline {5.1}}
 Statistical Derivation (Monatomic)}{9}{subsection.5.1}% contentsline {subsection}{numberline {5.2}}
 Ideal Gas Law and Molar Quantities}{9}{subsection.5.2}% contentsline {subsection}{numberline {5.3}}
 Specific Heats (Monatomic)}{9}{subsection.5.3}% contentsline {subsection}{numberline {5.4}}Adiabatic
 Index}{10}{subsection.5.4}% contentsline {subsection}{numberline {5.5}}Ideal Gas Processes}{10}
 {subsection.5.5}% contentsline {section}{numberline {6}}Thermodynamic Potentials}{10}{section.6}%
 contentsline {section}{numberline {7}}Maxwell Relations}{11}{section.7}% contentsline {subsection}
 {numberline {7.1}}Relation between Heat Capacities}{11}{subsection.7.1}% contentsline {subsection}
 {numberline {7.2}}Implications of the Third Law ($S(T, V)$ as $T \rightarrow 0$)}{12}{subsection.7.2}% contentsline
 {section}{numberline {8}}Calculating Entropy and Energy from Measurables}{12}{section.8}%
 contentsline {subsection}{numberline {8.1}}Entropy $S(T, V)$ }{12}{subsection.8.1}% contentsline
 {subsection}{numberline {8.2}}Internal Energy $E(T, V)$ }{12}{subsection.8.2}% contentsline {section}
 {numberline {9}}Thermodynamic Processes}{13}{section.9}% contentsline {subsection}{numberline {9.1}}
 Free Expansion (Joule Expansion)}{13}{subsection.9.1}% contentsline {subsection}{numberline {9.2}}
 Joule-Thomson Process (Throttling)}{13}{subsection.9.2}% contentsline {section}{numberline {10}}Heat
 Engines and Refrigerators}{14}{section.10}% contentsline {subsection}{numberline {10.1}}Heat Engine}
 {14}{subsection.10.1}% contentsline {subsection}{numberline {10.2}}Refrigerator}{14}{subsection.10.2}%
 contentsline {section}{numberline {11}}Canonical Ensemble (Constant T, V, N)}{15}{section.11}%
 contentsline {subsection}{numberline {11.1}}Connection to Thermodynamics: Helmholtz Free Energy}
 {15}{subsection.11.1}% contentsline {subsection}{numberline {11.2}}First and Second Laws in Canonical
 Ensemble}{16}{subsection.11.2}% contentsline {subsection}{numberline {11.3}}Example: Maxwell
 Velocity Distribution}{16}{subsection.11.3}% contentsline {section}{numberline {12}}Grand Canonical
 Ensemble (Constant T, V, μ)}{17}{section.12}% contentsline {subsection}{numberline {12.1}}
 Connection to Thermodynamics: Grand Potential}{17}{subsection.12.1}% contentsline {section}
 {numberline {13}}Classical Ideal Gas Revisited}{17}{section.13}% contentsline {subsection}{numberline
 {13.1}}Partition Function (Canonical Ensemble)}{17}{subsection.13.1}% contentsline {section}
 {numberline {14}}Equipartition Theorem}{18}{section.14}% contentsline {subsection}{numberline {14.1}}

Examples}{19}{subsection.14.1}% contentsline {section}{numberline {15}Quantum Statistics Examples}
 {19}{section.15}% contentsline {subsection}{numberline {15.1}Harmonic Oscillator (Quantum)}{19}
 {subsection.15.1}% contentsline {subsection}{numberline {15.2}Einstein Solid}{20}{subsection.15.2}%
 contentsline {subsection}{numberline {15.3}Paramagnetism (Spin J)}{20}{subsection.15.3}%
 contentsline {section}{numberline {16}Elements of Kinetic Theory}{21}{section.16}% contentsline
 {subsection}{numberline {16.1}Maxwell Velocity and Speed Distributions}{21}{subsection.16.1}%
 contentsline {subsection}{numberline {16.2}Particle Flux and Effusion}{22}{subsection.16.2}%
 contentsline {subsection}{numberline {16.3}Pressure of an Ideal Gas}{22}{subsection.16.3}%