21 Stat Mech of Ideal Gas
Density of states as function of E and of |k|; $\tilde{g}(k)dk \sim L^d k^{d-1} dk$; $g(E)dE = \tilde{g}(k(E))$ (dk/dE) dE
$E \propto k^2$ for particles (with mass), $E \propto k$ for photons, phonons (no rest mass)
λ_{th} $Z_1 = V/\lambda_{th}^3$ $Z_N = Z_1^N/N!$ Then find F, U, S = (U–F)/T, C

22 Chemical potential
Definition, meaning; for ideal gas $\mu = k_B T \ln(n \lambda_{th}^3)$
Gibbs distribution $P_i = \mathcal{Z}^{-1} \exp[\beta(\mu N_i - E_i)]$
Ensembles: microcanonical, canonical, grand canonical
μ and chemical reactions; μ (p) and reference μ and p; equilibrium constant K

23 (NOT 23.7) Photons
Stefan-Boltzmann law, spectral energy density, power received by earth from sun, radiation pressure,
$g(\omega)$ for photons, black-body distribution, Wien's law
Einstein A & B coefficients , NOT cosmic background radiation

24 (NOT 24.3) Phonons
Einstein model, assumptions, results, C
Debye model (interacting particles), assumptions, results, C
NOT phonon dispersion

26 (NOT 26.2, pp. 291-3) Real gases: van der Waals gas: eqn of state, partition function
Coexistence and metastable states, Gibbs construction, NOT Dieterici eqn.
Law of corresponding states, basics of virial expansion

28 Phase transitions (NOT 28.5, 28.6)
Latent heat, Clausius-Clapeyron
Chemical potential as function of T or p NOT Gibbs phase rule, colligative properties
First-order vs. continuous phase transitions; how to tell

29 Fermi-Dirac and Bose-Einstein distribution functions and partition functions
g(E) for massive particles in various dimensions
N & U for bosons in terms of $Li_n(z)$; fugacity z
Ground state (T=0) of Fermi gas
Sommerfeld expansion and its uses for kT "small"

$$\int\limits_{-\infty}^{\infty} \phi(E) f_{FD}(E) dE = \int\limits_{0}^{E_F} \phi(E) dE + \frac{\pi^2}{6}(k_B T)^2 \left[\phi'(E_F) - \phi(E_F)\frac{g'(E_F)}{g(E_F)} \right]$$

Bose gas and Bose-Einstein condensation

General: Know low-T behavior of heat capacity C for all cases

Some important topics from previous tests, for review

Various views of pressure

Maxwell-Boltzmann distribution

Mean free path and collisions

Laws 0, 1, 2, 3 of thermodynamics

Adiabatic, isothermal, isobaric, and isochoric processes; Carnot cycle

Equipartition, for quadratic and non-quadratic modes