Problem set 1

Solve the two problems with written solutions to be submitted in a date to be announced.

The grade will take into account the written solutions as well as any discussion of these on the week after they were handed in.

1. Regimes of Particulate and Wave-like Behavior: Exercise 3.3 of BT.
2. Observations of Cosmic Microwave Radiation from Earth: Exercise 3.7 of BT.

Problem set 2

Solve the proposed problems with written solutions to be submitted in a date to be announced.

The grade will take into account the written solutions as well as any discussion of these on the week after they were handed in.

Either

1. Equation of State for Non-relativistic Classical Gas: Exercise 3.8 of BT
2. Equation of State for Relativistic, Electron-Degenerate Hydrogen: Exercise 3.10 of BT

Or

1. Specific Heat for Non-relativistic Degenerate Electrons in White Dwarfs and in Metals: Exercise 3.11 of BT

Problem set 3

Solve the proposed problems with written solutions to be submitted in a date to be announced.

Either

1. Solar Heating of the Earth - The Greenhouse Effect: Exercise 3.15 of BT.
2. Olbers' Paradox and Solar Furnace: Exercise 3.16 of BT.

Or

1. Neutron Diffusion in a Nuclear Reactor: Exercise 3.21 of BT

Problem set 4

Solve two of the proposed problems with written solutions to be submitted in a date to be announced.

1. Entropy of a Classical Non-Relativistic Perfect Gas in a Microcanonical Ensemble: Exercise 4.7 of BT.
2. Primordial Element Formation: Exercise 4.10 of BT.
3. Grand Canonical Ensemble for Ideal Relativistic Gas: Exercise 5.3 of BT

Problem set 5

Solve two of the proposed problems with written solutions to be submitted in a date to be announced.

1. Find the solution of the one-dimensional, $-\infty < x < +\infty$, Fokker-Planck equation for a free Brownian particle, i.e., external potential V = 0. Assume that at time t=0 the particle is at x=0. Plot the result as a function of x for several values of t. Calculate the moments $\langle x^n \rangle$ and compare with the results of the Langevin equation approach (<...> denotes the ensemble average).

2. Find the solution of the one-dimensional, $-\infty < x < +\infty$, Fokker-Planck equation for a Brownian particle in the external potential V(x) = mgx, where m is the particle mass, and g the gravitational acceleration. Assume that at time t = 0 the particle is at $x = x_0$. Plot the result as a function of x for several values of t, choose the value for x_0.

3. For a free one-dimensional Brownian particle starting at time t = 0 from x = 0, determine the probability density $P_x(t)$ that the particle will reach for the first time a given point x at a time in the interval (t, t + dt). [Remark: $P_x(t)$ dt is the probability that the particle will get from x = 0 to the point x, for the first time, in a time in the interval (t, t+dt)].