Example problems. *Not to be turned in — solutions given in the companion volume of solved problems:*

§9.1: 1
§9.2: 5
§9.3: 3, 13
§9.5: 11
§9.8: 4, 23, 25

Assigned problems. *All are to be turned in; five problems from Boas will be graded, and will be worth 20 points each. Problem A is extra credit.*

§9.1: 2 (for discussion of Snell's law, read §9.1; see solution to problem 1)
§9.2: 6, 7
§9.3: 2, 11
§9.5: 11

A. (Extra credit) Consider a hoop of radius R and mass M attached to a wall at point P and allowed to swing about that point (in the plane of the hoop). The angle made between the point P and the center of the hoop C relative to the vertical is $\alpha(t)$. Free to slide on the hoop is a bead of mass μ; its position on the hoop is described by the angle $\beta(t)$ relative to the vertical from the center C of the hoop. See next page for figure.

a Compute the gravitational potential energies V_{hoop} and V_{bead} for the system as a functions of α and β. Remember that the hoop behaves as if all of its mass was concentrated at the point C.

b Compute the kinetic energy T_{hoop} as a function of $\dot{\alpha}$. You can think of this as the sum of two contributions: the rotational energy of a mass M at the point C rotating about P, plus the rotational energy of the hoop about the point C (called the "parallel axis theorem" in mechanics).

c Compute the kinetic energy T_{bead} as a function of α, β, $\dot{\alpha}$ and $\dot{\beta}$. Hint: write $T_{\text{bead}} = 1/2\mu(\dot{x}^2 + \dot{y}^2)$, where x and y are the coordinates of the bead, then express x and y in terms of α and β.

d Now construct the Lagrangian, and write down the Euler Lagrange equations for α and β. No need to solve them, unless you want to.