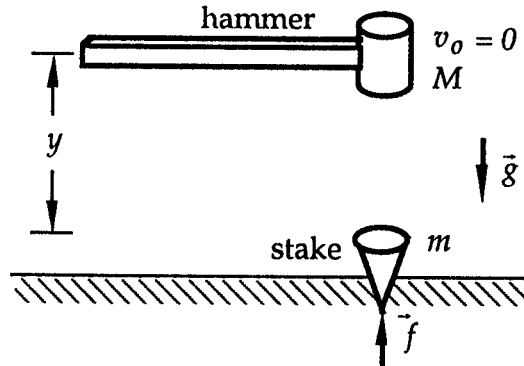**1. (16%)** A hammer of mass M falls from a height y on the top of a stake of mass m. After the impact, if the hammer and the stack stay together and the stack is driven into the ground a distance d. Please find the resistant force, f, of the ground.


2. (16%) A rod of mass M and length ℓ is at rest on a frictionless surface. An impulse $F\Delta t$ is applied at right angle at a distance $\ell/3$ from one end of the rod. Describe the subsequent motion of the rod after it has been struck.
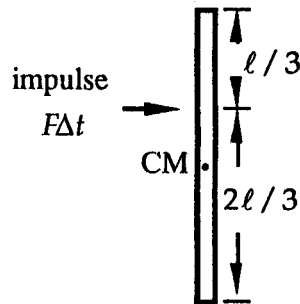
3. (18%)

(a) Explain the following terms of hydrodynamics: (i) equation of continuity, and (ii) Bernoulli's equation

(b) On the right, the figure is a crude model for a perfume atomizer. When the bulb at A is compressed, air flows swiftly through the tiny tube BC. The liquid will rise in the tube and enters BC and is sprayed out. If the pressure in the bulb is $P_a + P$, where P_a is atmospheric pressure, and v is the speed of the air in BC. The density of air and liquid are ρ_a and ρ, respectively. (i) Find the pressure in BC. (ii) How large would v need to be to cause the liquid to rise to BC?
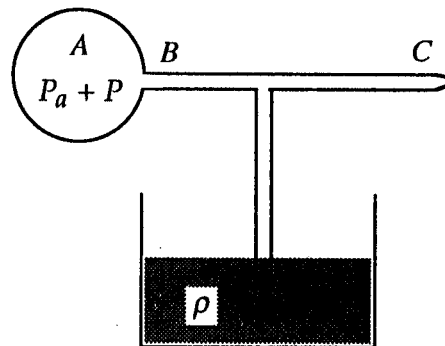
4. (16%) For an ideal gas undergoing an adiabatic process, the pressure and temperature of the gas is related by $T^\gamma P^{1-\gamma} = const$, where $\gamma \equiv \dfrac{C_V}{C_P}$.

(a) Assume the air behaves like an ideal gas. Try to find how the temperature vary with the altitude.

(b) If at the sea level the ambient temperature is 300 K, what is the temperature on the top of Jade Mountain (玉山, altitude is 4000 m)? (If the molecular weight of air is approximately 0.029 kg/mole and R is 8.3 J/K mole.)

5. (18%) A dielectric is pulled from between the plates of a capacitor which remains connected to a battery. What kind of changes (increase or decrease) occur to

(a) the capacitance,

(b) the charges on the plates,

(c) the potential difference on the plates,

(d) the energy stored between the plates, and

(e) the electric field between the plates.

6. (16%) If the electric current , I, flows through a capacitor is changing with time. Assume the plate is very large and the edge effect can be neglect. Please find

(a) the relation between the electric field, E, in the plate and the current, and

(b) the relation between the magnetic field, B, in the plate and the current.