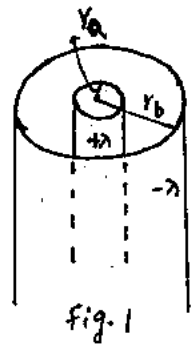


(-) A long, straight coaxial cable (see fig. 1) has an inner wire of radius r_a that carries a linear charge density λ (C/m), and an outer cylindrical shell of radius r_b that has a linear charge density $-\lambda$.

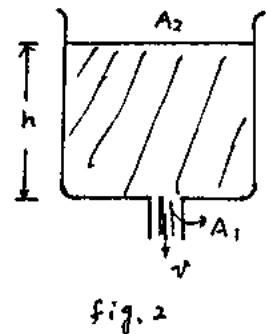


(1.) Find the electric field in the regions ① $r < r_a$
② $r_a < r < r_b$ ③ $r > r_b$

(2.) Find the electric potential in the regions ① $r < r_a$ ② $r_a < r < r_b$ ③ $r > r_b$

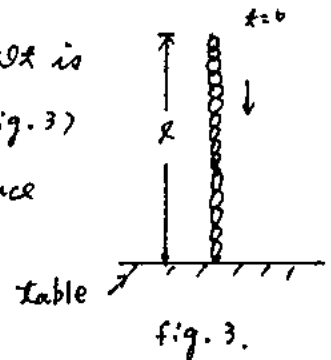
(3.) Find the capacitance of a length l assuming that air is between the cylindrical capacitor?

(5) Water drains through an opening of area A_1 in a container of cross-sectional area A_2 . (see fig. 2) If the motion of water surface in the container is not ignored, find the speed $v = ?$ at which the water emerges.



(E) A vertical chain has a length l and a mass M . It is released with the bottom just touching a table; (see fig. 3) Find ① the force on the table as a function of the distance fallen by the top end?

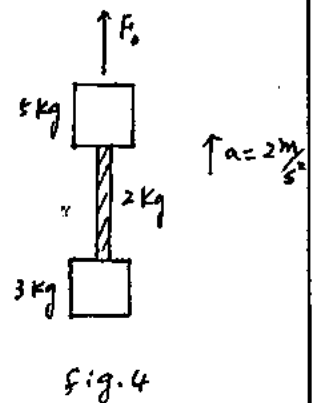
② the maximum force on the table?



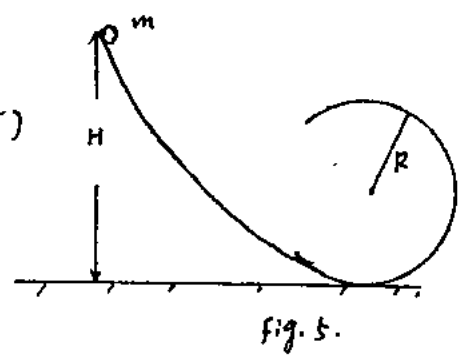
(D) A 5 kg block has a rope of mass 2 kg attached to its underside and a 3 kg block is suspended from the other end of the rope. (see fig. 4) The whole system is accelerated upward at 2 m/sec^2 by an external force F_0

① what is F_0 ?

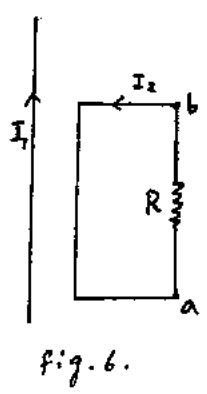
② what is the net force on the rope?



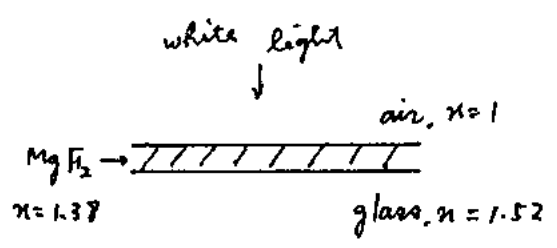
(五) A marble of radius r rolls without slipping 15% down an incline and then up along a vertical circular track of radius R . (see fig. 5) what is the minimum height H from which the ball must start so that it barely stays in contact at the top of the circle?
assume $r \ll H$, $r \ll R$.



(六) The current, I_1 , in a long, straight wire changes 10% in time. The current I_2 induced in the nearby loop, (see fig. 6), flows from a to b in the resistor. If a voltmeter is connected between a and b, what will it read?

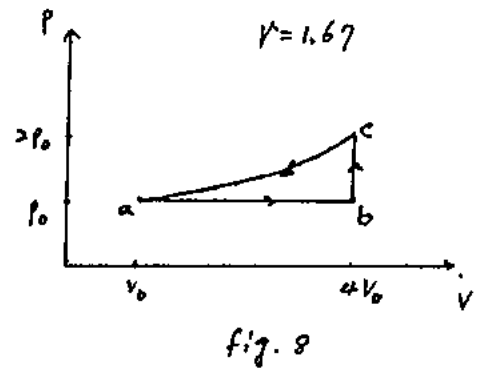


(七) White light is incident normally on a 10% glass ($n=1.52$), that is coated with a film of MgF_2 ($n=1.38$). For what minimum thickness of the film will yellow light of wavelength 5800 \AA (in air) be missing in the reflected light?



(八) One mole of an ideal monatomic gas is 15% caused to go through the cycle (see fig. 8)

- ① How much work is done in expanding the gas from a to c along path abc?
- ② What is the change in internal energy and entropy in going from b to c?
- ③ What is the change in internal energy and entropy in going through one complete cycle?



point a : (P_0, V_0, T_0)