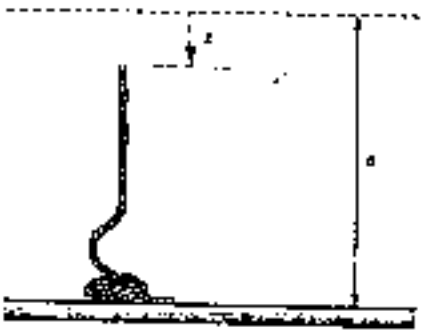
八十六學年度 物理 系(所) 物理 組碩士班研究生入學考試

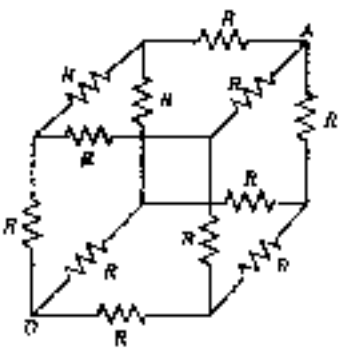
科目 古典物理 科號 0402 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. Consider a rope of mass per unit length m and length a suspended just above a table as shown in the following figure. If the rope is released from rest at the top, find the force on the table when a length x of the rope has dropped to the table. [15%]



2. A water drop falling in the atmosphere is spherical in shape. As the drop passes through a cloud, the mass of the drop increases at a rate proportional to the cross-sectional area of the drop multiplied by the speed of fall. If the drop starts from the rest when it is infinitely small, determine the acceleration. [15%]

3. Twelve identical resistors form a cube as shown in the following figure. Find the equivalent resistance between the points A and D. [10%]



4. Two identical ideal monatomic gases with the same pressure P and the same number of particles N, but with different absolute temperatures T_1 and T_2, are confined in two boxes, of volume V_1 and V_2, which are then connected. Find the change in entropy after the system has reached equilibrium. [15%]

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5. The equation of state for a van der Waals gas is

$$P = \frac{RT}{V-b} - \frac{a}{V^2}.$$

Calculate the critical temperature, critical volume and critical pressure. [15%]

6. Consider a point charge Q near a grounded conducting sphere of radius a as shown in the following figure. The point charge is at a distance D from the center of the sphere. Determine the total induced charge on the conducting sphere. [15%]

7. A flywheel of radius R, with charge Q uniformly distributed along the edge, rotates with angular velocity ω. What is the rate at which energy is radiated by the system? [15%]