

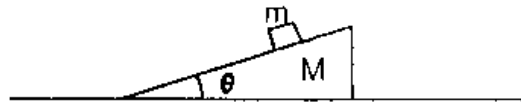
國立中央大學八十六學年度碩士班研究生入學試題卷

所別: 光電科學研究所 不分組 科目:

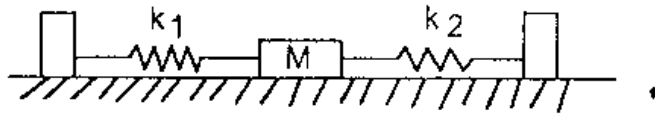
普通物理

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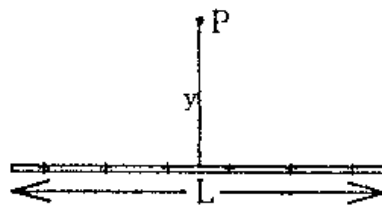
1. A wedge of mass M , whose faces form an angle θ with each other, lies on a smooth horizontal table. A block of mass m is placed on the wedge and is allowed to slide down. Neglect all friction. What is the acceleration of the wedge along the table (before the block reaches the table)? (15%)



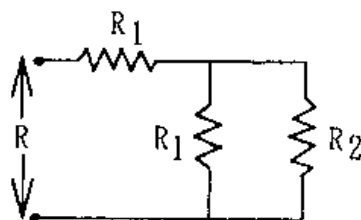
2. A block of mass M rests on a frictionless horizontal table and is connected to two fixed posts by springs having spring constants k_1 and k_2 respectively.
- (a) If the block is displaced slightly from its equilibrium position, what is the frequency of vibration? Suppose that the block is vibrating with amplitude A and that, at the instant that it is passing through its equilibrium position, a mass m is dropped vertically onto the block and sticks to it. Find:
- (b) the new frequency of vibration;
- (c) the new amplitude of vibration. (15%)



3. A thin nonconducting rod of finite length L carries a total charge Q , spread uniformly along it. Find the exact expression for the electric field E at point P on the perpendicular bisector (see the following figure). (10%)



4. Given the resistor arrangement shown in the figure below, find the relation between R_1 and R_2 (i.e., $R_2 = ? R_1$) so that the resistance of the system be equal to R_2 . (10%)



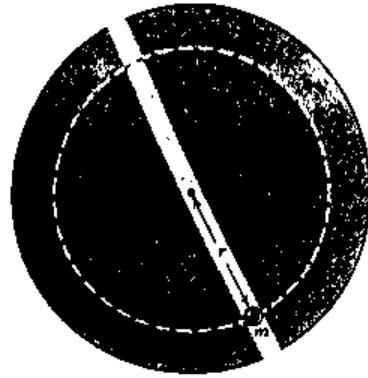
5. Suppose a tunnel could be dug through the earth from one side to the other along a diameter, as shown in the following figure. Show that the motion of a particle dropped into the tunnel is the simple harmonic motion. Neglect all frictional forces and assume that the earth has a uniform density. (10%)

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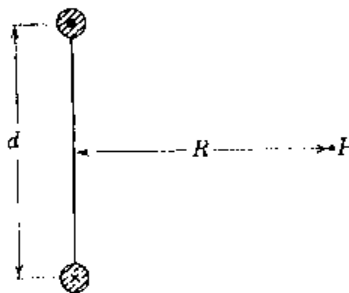
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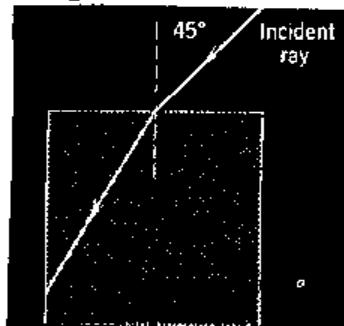
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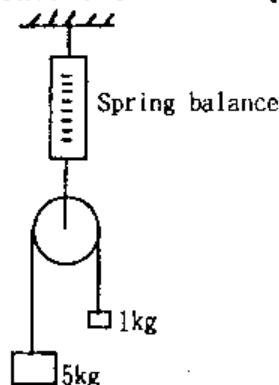
6. Two long wires a distance d apart carry equal antiparallel currents i , as shown in the figure below. Find the exact expression of B at point P , which is equidistant from the wires. (10%)



7. A light ray falls on a square glass slab as in the figure below. What must the index of refraction of the glass be if total internal refraction occurs at the vertical face? (10%)



8. In the figure, a pulley of negligible weight is suspended by a spring balance. Weights of 1 kg and 5 kg, respectively, are attached to opposite ends of a string passing over the pulley and moves with acceleration because of gravity. During their motion, will the spring balance read a weight of 6 kg, less than 6 kg, or more than 6 kg? (*Calculate it!* Do not just write down the answer!) (10%)



9. Consider two concentric spherical metal shells of radii r_1 and r_2 ($r_2 > r_1$). If the outer shell has a charge Q and the inner shell is grounded, what is its charge? (10%)