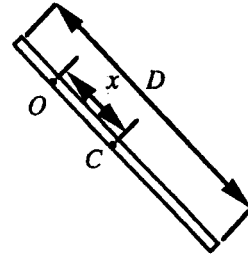


1. (15%) A uniform rod of length D forms a physical pendulum that rotates about the point O , which is a distance x from the center of gravity C . (a) Find the expression for the period T in terms of x and D . (b) Under what condition that T will have its minimum value? Find the expression for the minimum value of T .



2. (15%) A 1-kg aluminum block that is initially at a temperature of 400 K is put into 1-kg of water that is initially at a temperature of 300 K. The container of the combined system is insulated so that there is no heat flow to the surroundings. Please find the total change of entropy. (Specific heats of water and aluminum are about 4180 J/kg-K and 900 J/kg-K, respectively.)
3. (15%) A spherical shell of radius a carries a uniform surface charge density σ , and spins with frequency f on an axis through its center. Please find the magnetic moment of this shell.
4. (15%) (a) Write down the relation between \mathbf{B} , \mathbf{H} and \mathbf{M} for an isotropic medium and explain, concisely, the meanings of \mathbf{B} , \mathbf{H} and \mathbf{M} . (b) How do you define the magnetic permeability of materials? (c) How many different types of magnetic materials are there? How do you classify them according to the range of their magnetic permeability?
5. (15%) (a) Sketch the temperature-dependence of the electric resistivity for insulators, semiconductors and metals. (b) What are the origins of the electric resistivity of metals.

6. (10%) If you are doing an experiment which is very sensitive to external electric interferences. Please sketch and explain how you go about to screen out the external electric interferences.

7. (15%) A circuit consists of a battery with emf ϵ , two identical resistors with resistivity R , two identical copper plates, a capacitor with capacitance C and a ballistic galvanometer. The separation of these two copper plates is l . After the capacitor has been fully charged up to Q_0 , a bullet with velocity v breaks plate-1 and the capacitor starts to discharge until the bullet breaks plate-2. If the reading of the ballistic galvanometer tells us that the total amount of charge flows through the discharging circuit is Q during that period. Please find the velocity of the bullet in terms of the above mentioned parameters.

