

Physics 31B 1st Test (100pts)
Spring, 2003

<I>. (A). Suppose you have two different kinds of cells: four large 1.5-V cells that can operate at 4.0 A and ten small 1.5-V cells that can operate at 1.0 A. Design a 4.5-V battery that can supply 8.0 A and, moreover, use all the large cells. How many of the small size will you need?

<I>. (B). A 100-V electric heater draws 10A. What is its resistance?

<II>. Suppose someone falling out of a tree grabs an overhead power line. The wire has a resistance of 60 microhms per meter and is carrying a dc current of 1000 amps. With hands a meter apart, what is the voltage across him? Will the unfortunate soul get much of a shock?

<III>. (A). A 100-pF capacitor is charged by putting it across a 1.5-V battery. What is the charge on its plates?

<III>. (B). A parallel-plate capacitor immersed in transformer oil carries a charge of + 20 μC on one plate and - 20 μC on the other when there is a voltage of 4.0 V across it. What is its capacitance?

<IV>. The electric potential on the symmetry axis of a uniformly charged ring of radius R at a distance x is

$$V(x) = k_0 \frac{Q}{\sqrt{x^2 + R^2}}$$

Where Q is the total positive charge it carries. Compute the scalar axial electric field.

<V>. On the black board diagram shows a wire carrying a charge Q uniformly distributed along its length L . Prove that the force acting on a charge q placed at point P right in the middle at a distance h is given by

$$F = \frac{kqQ}{h\sqrt{(L/2)^2 + h^2}}$$

<VI>. A narrow ring carries a uniformly distributed net charge Q . Find the electric field it produces at a point P on the central axis an arbitrary distance x from the plane of the ring. Assume the medium is air.