Chapter D - Problems

Blinn College - Physics 2426 - Terry Honan

Problem D.1

Two electrically neutral conductors sit near each other. If a 12 V car battery is connected across the conductors then a total charge of 30 pC flows putting charges of ± 30 pC on the conductors.

(a) If two car batteries are used to create a 24 V potential difference between the conductors, then what is the total charge that flows?

(b) What is the capacitance of this configuration?

Problem D.2

An empty parallel plate capacitor with a plate separation of 2 mm is connected across a 12 V battery.

(a) What is the electric field between the plates?

(b) What is the surface charge density on each plate?

(c) If the charge on the each plate is 300 pC then what is its capacitance and what is the surface area of the plates in cm^2?

Problem D.3

A 30 m long coaxial cable has an inner conductor with a 2.5 mm diameter and an outer conductor with an inside diameter of 7 mm and an outer diameter of 8 mm. Suppose it is connected across a 1.5 V battery with the positive terminal connected to the inner conductor. What is the charge on each conductor? Assume the insulator between the conductors behaves as a vacuum.

Problem D.4

A conducting sphere with a 12 cm radius sits inside a hollow conducting sphere with an inside radius of 15 cm and an outside radius of 20 cm, where all spherical surfaces are concentric. Suppose this is connected across a potential difference of 200 V. Assume the region between the conductors is a vacuum.

(a) What is the magnitude of the charge that flows?

(b) How much energy is stored in this configuration?

Problem D.5

A uniform electric field with a 300 V/m magnitude is in a room with dimensions 4 m $\times$ 6 m $\times$ 3 m.

(a) What is the electric energy density in this field?

(b) What is the total electric energy in the room?

Problem D.6

The water molecule H_2O had a dipole moment of $6.3\times10^{-30}\,\mathrm{C\cdot m}$. What is the maximum torque on a water molecule in an electric field of magnitude $5000\,\mathrm{V/m}$? How much work is required to rotate this from an aligned position to an anti-aligned (opposite the field) position in the same field?

Problem D.7

A parallel plate capacitor with a plate area of $30\,\mathrm{cm}^2$ and a plate separation of 2 mm is connected across a 250 V source.
(a) What are the electric field between the plates, the charge on the plates and the total energy stored?
(b) While still connected across the 250 V source suppose the plates are dropped into distilled water. What are the electric field between the plates, the charge on the plates and the total energy stored?
(c) Suppose instead the 250 V source is disconnected before the plates are dropped into distilled water. What are the electric field between the plates, the charge on the plates and the total energy stored?