

General Physics IIA — Quest 2 (1 Hour)

Part I – Conceptual Questions (30 points)

1. Two identical positive point charges are fixed in space.
 - (a) How does the electric force change if the distance between them is tripled?
 - (b) How does the electric field at the location of one charge due to the other change if the distance is tripled?
2. Consider electric field lines around an isolated positive point charge.
 - (a) Do field lines ever cross? Why or why not?
 - (b) What does the density of field lines indicate physically?
 - (c) In what direction does the electric field point relative to the charge?
3. A hollow metal sphere is placed in electrostatic equilibrium.
 - (a) What is the electric field inside the conducting material?
 - (b) Where does the excess charge reside?
 - (c) What does Gauss' law tell us about the net electric flux through a Gaussian surface inside the conductor?
4. Rank the electric potential (highest to lowest) at points A, B, and C located at distances $1r$, $2r$, and $3r$ from a positive point charge. Explain briefly.
5. A parallel-plate capacitor is connected to a battery and then disconnected. A dielectric slab is inserted fully between the plates.
 - (a) Does the capacitance increase, decrease, or stay the same?
 - (b) Does the charge on the plates change?
 - (c) Does the voltage change?

Part II – Problems (70 points)

1. Coulomb's Law

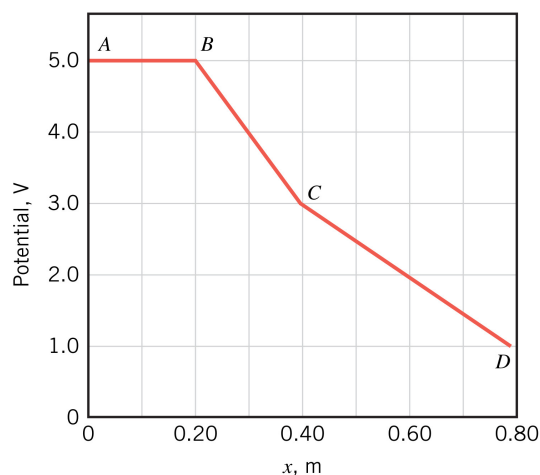
Two tiny conducting spheres are identical and carry charges of $-27.9\mu\text{C}$ and $+64.8\mu\text{C}$. They are separated by a distance of 3.72 cm

- (a) What is the magnitude of the force that each sphere experiences?
- (b) The spheres are brought into contact and then separated to a distance of 3.72 cm. Determine the magnitude of the force that each sphere now experiences.

2. Electric Field and Potential

The drawing shows the electric potential as a function of distance along the x axis.

- (a) Determine the magnitude of the electric field in the regions A to B , B to C , and C to D ,
- (b) If a $-1.0\mu\text{C}$ charge is placed at $x = 0.20\text{ m}$, what is the magnitude of the force that acts on it?



3. Gauss' Law

A charge Q is located inside a rectangular box. The electric flux through each of the six surfaces of the box is: $\Phi_1 = +5750\text{ Nm}^2/\text{C}$, $\Phi_2 = +3840\text{ Nm}^2/\text{C}$, $\Phi_3 = +1110\text{ Nm}^2/\text{C}$, $\Phi_4 = -2870\text{ Nm}^2/\text{C}$, $\Phi_5 = -3200\text{ Nm}^2/\text{C}$, $\Phi_6 = -3040\text{ Nm}^2/\text{C}$.

What is Q ?

4. Electric Potential and Potential Energy

Two point charges, $+2.10\mu\text{C}$ and $-6.10\mu\text{C}$, are separated by 1.70 m. What is the electric potential midway between them?

5. Capacitors and Dielectrics

What is the capacitance of a capacitor that stores $1.7\mu\text{C}$ of charge on its plates when a voltage of 4.8 V is applied between them?