

General Physics IIA — Practice Quiz (1 Hour)

Part I – Conceptual Questions

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

Part II – Problems

1. Coulomb's Law

Two charges are located on the x -axis:

- $q_1 = +4.0\mu\text{C}$ at $x = 0$ m
- $q_2 = -2.0\mu\text{C}$ at $x = 0.3$ m

- (a) Find the magnitude and direction of the force on q_2 .
- (b) Is the force attractive or repulsive?

2. Electric Field from Point Charges

A $+3.0\mu\text{C}$ charge is located at the origin.

- (a) Calculate the electric field magnitude at a point 0.20 m away.
- (b) If a $-1.0\mu\text{C}$ charge is placed at that point (0.20 m away), what force acts on it?
- (c) What is the direction of the force relative to the field?

3. Net Electric Field

Two identical positive charges $q = +5.0\mu\text{C}$ are placed 0.40 m apart.

- (a) Find the electric field at the midpoint between them.
- (b) Find the electric field at a point 0.20 m to the right of the right-hand charge. Draw a simple diagram and indicate directions clearly.

4. Gauss' Law

A point charge of $+6.0\mu\text{C}$ is located at the center of a spherical surface of radius 0.50 m.

- (a) Calculate the electric flux through the sphere.
- (b) If the radius is doubled, what happens to the flux? Explain using Gauss' law.

5. Electric Potential and Potential Energy

A $+2.0\mu\text{C}$ charge is fixed in place.

- (a) What is the electric potential 0.50 m from the charge?
- (b) What is the electric potential energy of a $-3.0\mu\text{C}$ charge placed at that point?
- (c) If released from rest, would the $-3.0\mu\text{C}$ charge move toward or away from the $+2.0\mu\text{C}$ charge?

6. Capacitors and Dielectrics

A parallel-plate capacitor has:

- Plate area = 0.020m^2
- Plate separation = 2.0mm
- No dielectric initially

- (a) Calculate the capacitance.
- (b) If connected to a 12 V battery, how much charge is stored?
- (c) If a dielectric with $\kappa = 4.0$ is inserted while still connected to the battery, what is the new capacitance?
- (d) What is the new charge?