Practice Exam: Calculus-Based Physics II
Electrostatics

Part I: Electric Field

1. A point charge $+3.0\,\mu C$ is located at the origin. Calculate the electric field vector at the point $(0.03\,\text{m}, 0.04\,\text{m})$.

2. A long, thin rod of uniform charge density $\lambda = 2.0\,\mu\text{C/m}$ lies along the x-axis from $x = 0$ to $x = 1.0$ m. Find the electric field at the point $(0, 0.5)$ m.

Part II: Gauss's Law

3. A solid non-conducting sphere of radius $R = 0.10\,\text{m}$ has a uniform charge density $\rho = 200\,\mu\text{C/m}^3$. Find the electric field at a distance $r = 0.05\,\text{m}$ from the center.

4. A cylindrical shell of radius $R = 5.0\,\text{cm}$ carries a uniform surface charge density $\sigma = 3.0\,\mu\text{C/m}^2$. Use Gauss's Law to find the electric field both inside and outside the cylinder.

Part III: Electric Potential and Potential Energy

5. Two charges, $+2.0\,\mu C$ and $-2.0\,\mu C$, are separated by 6.0 cm. Find the electric potential at a point midway between them.

6. A charge of $+1.0\,\mu C$ is placed in an electric potential field such that the potential at its location is 12.0 V. What is the electric potential energy of the charge?

Part IV: Potential and Field

7. The electric potential in a region of space is given by $V(x, y) = 5x^2 - 3y$. Find the electric field vector $\vec{E}(x, y)$.

8. A proton is released from rest in a region where the electric potential decreases uniformly by 10 V over a distance of 2.0 cm. Find the magnitude of the electric field and the kinetic energy of the proton after traveling the distance.