

1 Coordinate Systems

1.1 Cartesian Coordinates

Definition:

- Position vector

$$\mathbf{R} = x\mathbf{a}_x + y\mathbf{a}_y + z\mathbf{a}_z \quad (1)$$

- Differential length elements

$$d\mathbf{l}_x = \mathbf{a}_x dx, \quad d\mathbf{l}_y = \mathbf{a}_y dy, \quad d\mathbf{l}_z = \mathbf{a}_z dz \quad (2)$$

- Differential surface elements

$$d\mathbf{S}_x = \mathbf{a}_x dydz, \quad d\mathbf{S}_y = \mathbf{a}_y dzdx, \quad d\mathbf{S}_z = \mathbf{a}_z dxdy \quad (3)$$

- Differential volume elements

$$dV = dxdydz \quad (4)$$

1.2 Cylindrical Coordinates

Definition:

1.3 Spherical Coordinates

Definition:

2 Electric Field

2.1 Coloumb's Law

Definition:

$$\mathbf{F}_{12} = \frac{q_1 q_2}{4\pi\epsilon_0} \frac{\mathbf{R}_2 - \mathbf{R}_1}{|\mathbf{R}_2 - \mathbf{R}_1|^3} \quad (5)$$

2.2 Guass Law

Definition:

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0} \quad (6)$$

$$\oint_S \mathbf{E} \cdot d\mathbf{S} = \frac{Q_{\text{enc}}}{\epsilon_0} \quad (7)$$