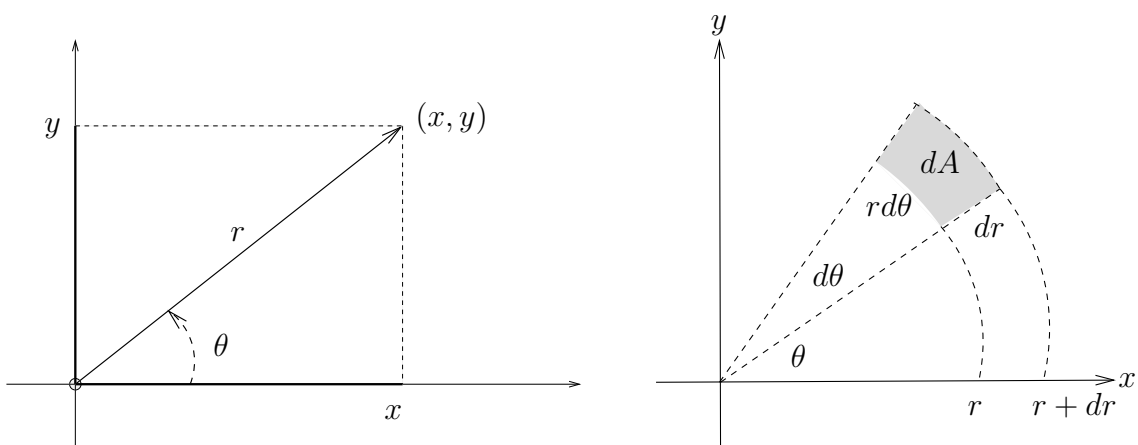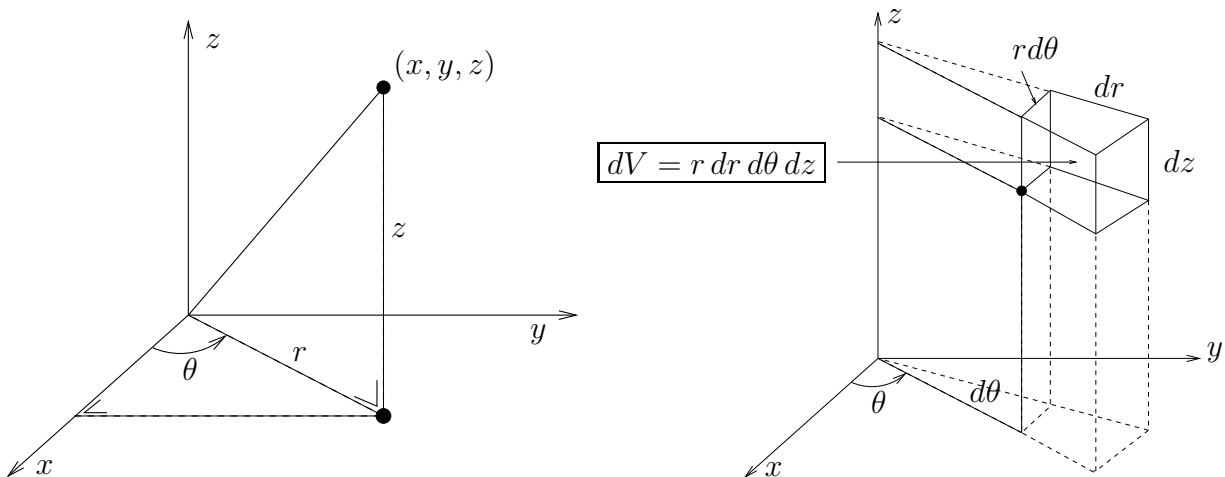# Coordinate Systems

Polar coordinates

$$x = r\cos\theta, \quad y = r\sin\theta, \quad \text{and} \quad dA = r\,dr\,d\theta$$

Cylindrical coordinates

$$x = r\cos\theta, \quad y = r\sin\theta, \quad z = z, \quad \text{and} \quad dV = r\,dr\,d\theta\,dz$$

Spherical coordinates

$$x = \rho \sin \phi \cos \theta, \quad y = \rho \sin \phi \sin \theta, \quad z = \rho \cos \phi, \quad \text{and} \quad dV = \rho^2 \sin \phi \, d\rho \, d\phi \, d\theta$$

$$dV = \rho^2 \sin \phi \, d\rho \, d\phi \, d\theta$$