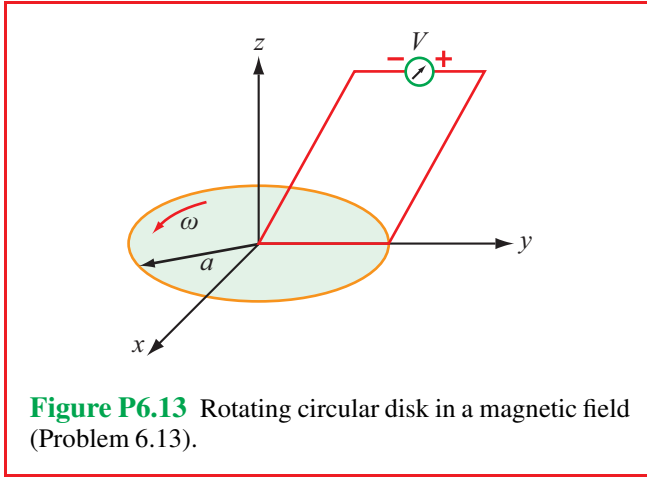


6.13 The circular, conducting, disk shown in P6.13 lies in the x - y plane and rotates with uniform angular velocity ω about the z -axis. The disk is of radius a and is present in a uniform magnetic flux density $\mathbf{B} = \hat{\mathbf{z}}B_0$. Obtain an expression for the emf induced at the rim relative to the center of the disk.



Solution:

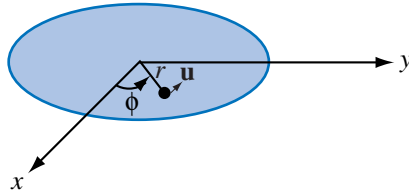


Figure P6.13 (a) Velocity vector \mathbf{u} .

At a radial distance r , the velocity is

$$\mathbf{u} = \hat{\phi} \omega r$$

where ϕ is the angle in the x - y plane shown in the figure. The induced voltage is

$$V = \int_0^a (\mathbf{u} \times \mathbf{B}) \cdot d\mathbf{l} = \int_0^a [(\hat{\phi} \omega r) \times \hat{\mathbf{z}} B_0] \cdot \hat{\mathbf{r}} dr.$$

$\hat{\phi} \times \hat{\mathbf{z}}$ is along $\hat{\mathbf{r}}$. Hence,

$$V = \omega B_0 \int_0^a r dr = \frac{\omega B_0 a^2}{2}.$$