$$\Phi = \int_0^b \left[\hat{a}_z B_0 \cos\frac{\pi r}{2b} \sin\omega t \right] \cdot (\hat{a}_z \cdot 2\pi r)\, dr$$

$$= 2\pi B_0 \sin\omega t \int_0^b \cos\frac{\pi r}{2b} \cdot r\, dr$$

$$= 2\pi B_0 \sin\omega t \cdot \frac{2b}{\pi} \int_0^b r\, d\left(\sin\frac{\pi}{2b} r\right)$$

$$= 4b B_0 \sin\omega t \left[r \cdot \sin\frac{\pi r}{2b} \Big|_0^b - \int_0^b \sin\frac{\pi r}{2b}\, dr \right]$$

$$= 4b B_0 \sin\omega t \left[b + \frac{2b}{\pi} \cos\frac{\pi r}{2b} \Big|_0^b \right]$$

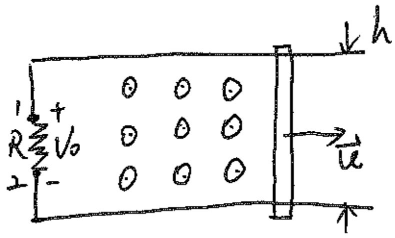
$$= 4b B_0 \sin\omega t \left[b \cancel{\mp} - \frac{2b}{\pi} \right]$$

$$= 8b^2 B_0 \sin\omega t \left[\frac{1}{2} - \frac{1}{\pi} \right] = \frac{8b^2 B_0 \sin\omega t}{\pi} \left[\frac{\pi}{2} - 1 \right]$$

$$V = -N \frac{d\Phi}{dt} = -N \frac{8b^2 B_0 \omega \cdot \cos\omega t}{\pi} \left[\frac{\pi}{2} - 1 \right]$$

A circular Loop of N turns of conducting wire lies in the x-y plane with its centre at the origin of a magnetic field specified by $\vec{B} = \hat{a}_z B_0 \cos\left(\frac{\pi r}{2b}\right) \sin\omega t$, where b is the radius of the loop and ω is the angular frequency. Find the EMF induced in the loop.

A metal bar slides over a pair of conducting rails in a uniform magnetic field $\vec{B} = \hat{a}_z B_0$ with a constant velocity $\vec{u}$.



a). Determine the open-circuit voltage V_0.

b). Assume R is connected. Find dissipated power over R.

c) Prove electric power = mechanical power

a). $V_0 = -\dfrac{d\Phi}{dt} = \dfrac{-d[\hat{a}_z B_0 \cdot \hat{a}_z h l]}{dt} = -B_0 h \dfrac{dl}{dt} = -B_0 h u \quad (V)$ PP315

b) $P_e = \dfrac{(V_0)^2}{R} = \dfrac{(uB_0h)^2}{R}$

c) $I = \dfrac{V_0}{R} = -\dfrac{B_0 h u}{R} \quad (A)$ "$-$" current in Bar pointing downward.

$\cancel{F_m = q\vec{u}\times\vec{B} = I}$

$F_m = q\vec{v}\times\vec{B} = \{I \cdot h \cdot B_0\}$

$W_m = F_m \cdot dl$

$P_m = |F_m \cdot dl/dt| = |F_m \cdot u| = \dfrac{B_0 h u}{R} \cdot h B_0 u = \dfrac{(u h B_0)^2}{R}$