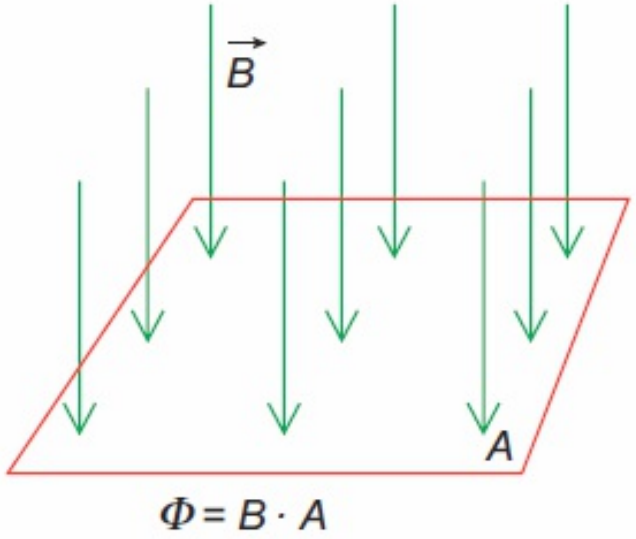
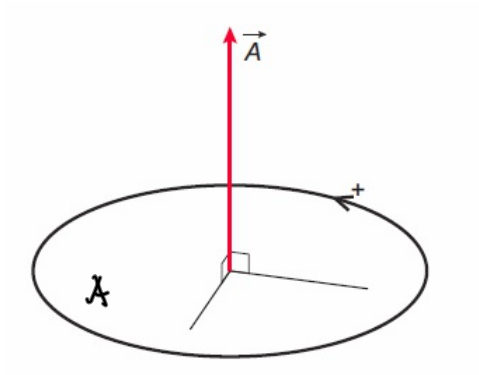
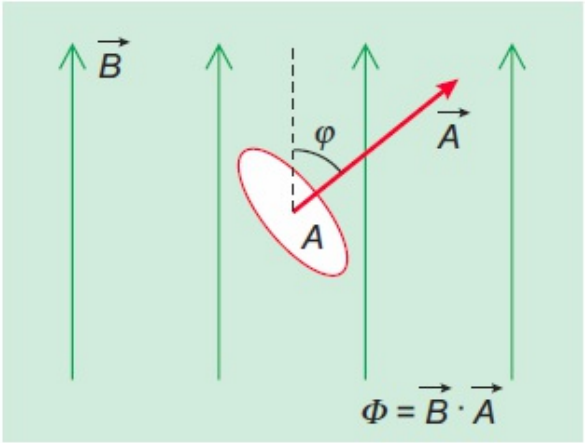
Kapittel 24:
Induksjon

Magnetisk fluks



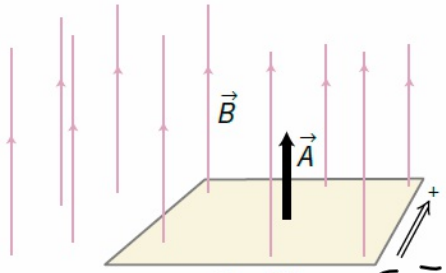




$= BA \cdot \cos\varphi$

A=50 cm^2

B=3,5mT

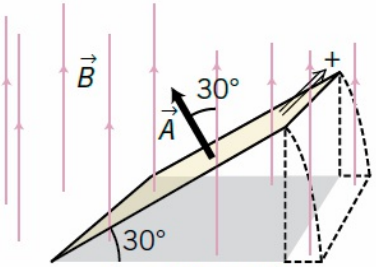


$\Phi = BA = 3{,}5\,mT \cdot 50 \cdot 10^{-4}\,m^2$

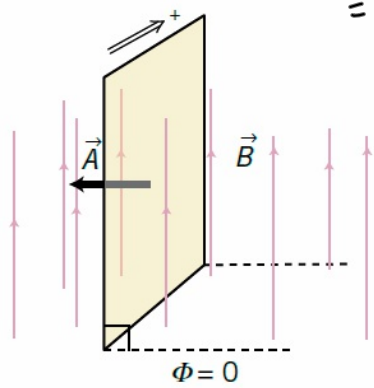
$= 18 \cdot 10^{-6} \cdot Tm^2 = 18\,\mu Wb$

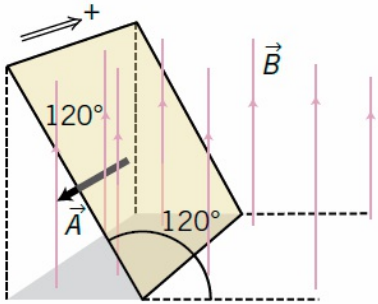
Wb

Weber



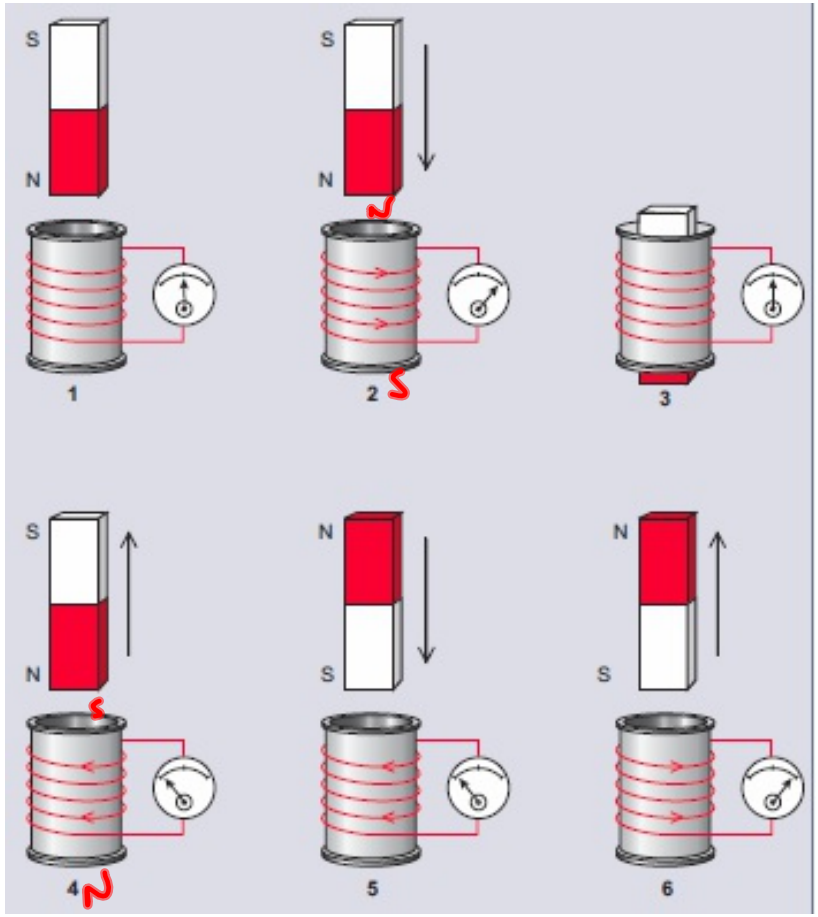
$\Phi = BA \cos 30° = 15\,\mu Wb$

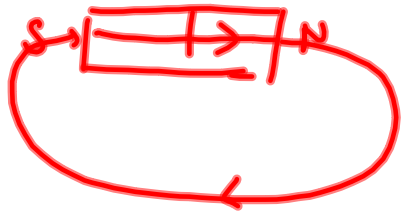




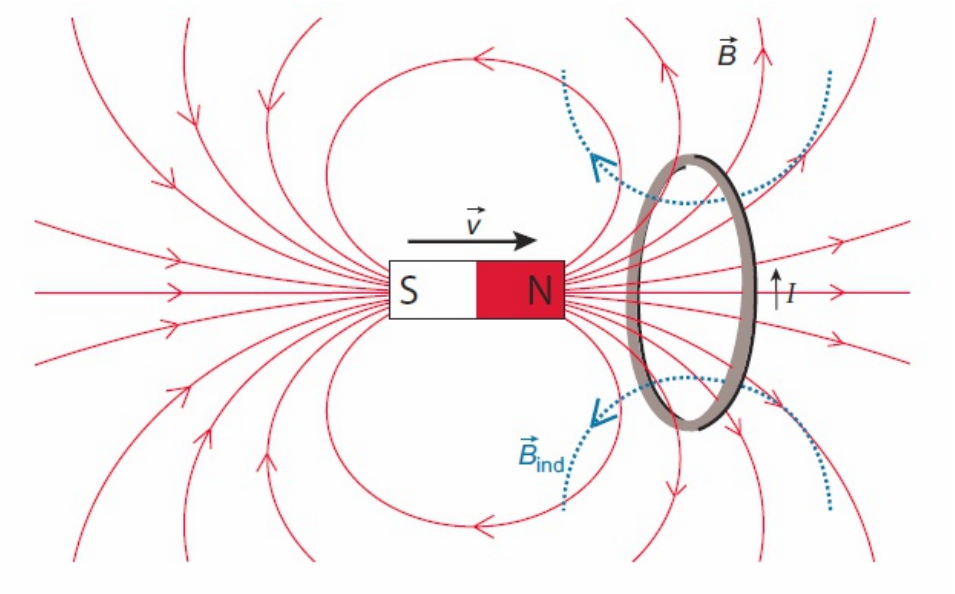
$\Phi = BA \cos 120°$

$= -8{,}8\,\mu Wb$





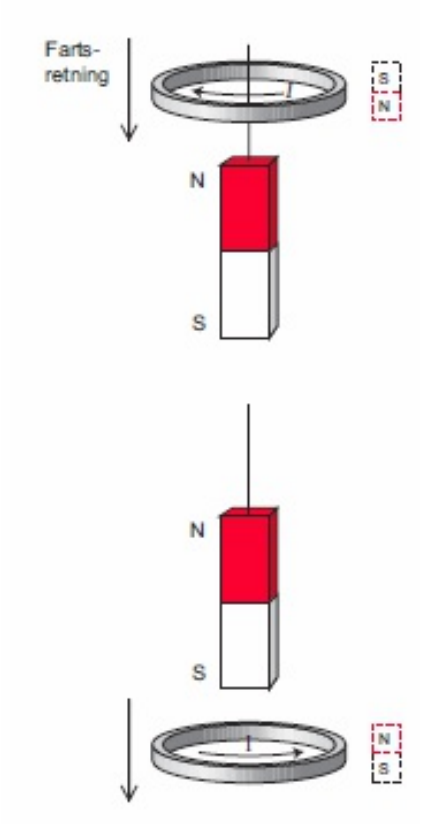
Lenz' regel >>> En indusert elektrisk strøm motvirker årsaken sin.



http://micro.magnet.fsu.edu/electromag/java/lenzlaw/index.html

Ringen faller over en stavmagnet

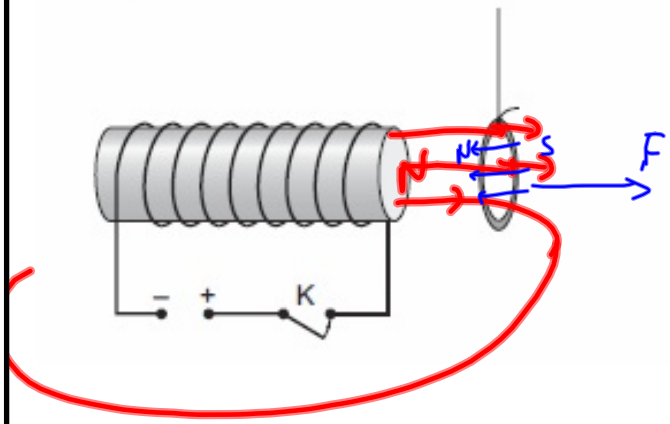
som henger i ro:



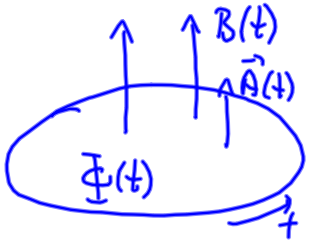
Samsnakk:

Forklar strømretningen i ringen

Figuren viser en kobberring som henger i en tråd nær den ene enden av en jernfylt spole. Når vi slår på strømmen med bryteren K, vil ringen bevege seg uten å dreie. Hvilken vei beveger den seg? Forklar fenomenet.



Faradays induksjonslov



$$\mathcal{E}(t) = -\frac{\Delta\Phi}{\Delta t} \xrightarrow{\Delta t \to 0} -\Phi'(t)$$

Elektromotorisk spenning (emk)

Enhet:

$\frac{\Delta\Phi}{\Delta t}$:

$$\frac{Wb}{s} = \frac{T\,m^2}{s} = \frac{N\,s\,m^2}{C\,m\,s} = \frac{J}{C} = V$$

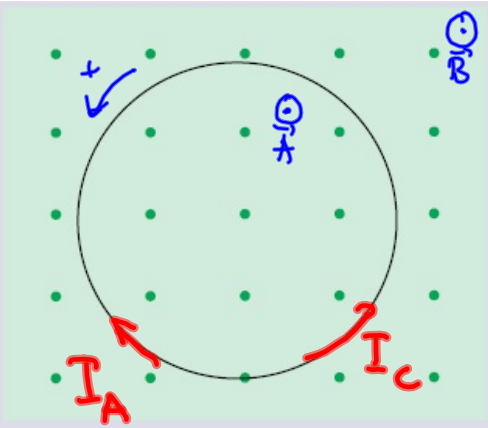
$\vec{F} = q \cdot \vec{v} \cdot \vec{B}$

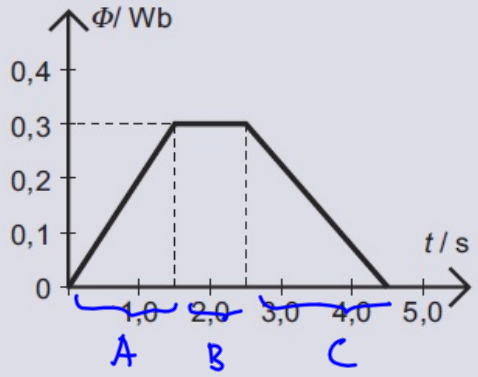
$N = C\ m/s\ T$

$T = \frac{N\,s}{C\,m}$

Eksempel

$$\mathcal{E} = -\frac{\Delta \Phi}{\Delta t} = -\Phi'(t)$$





En spole med $N = 100$ vindinger blir plassert i et magnetfelt.

A: $\Delta \Phi = 0{,}3$ Wb

$\Delta t = 1{,}5$ s

$\mathcal{E} = -N\frac{0{,}3\text{ Wb}}{1{,}5\text{ s}} = -20$ V

(N = 100)

B: $\Delta \Phi = 0$

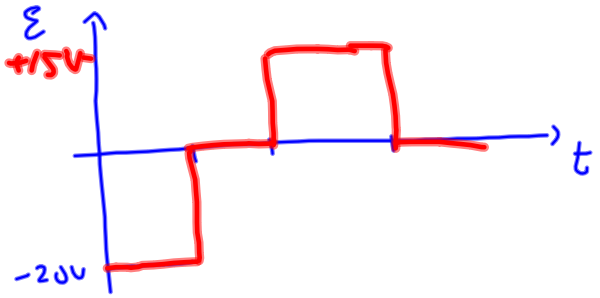
$\mathcal{E} = 0$

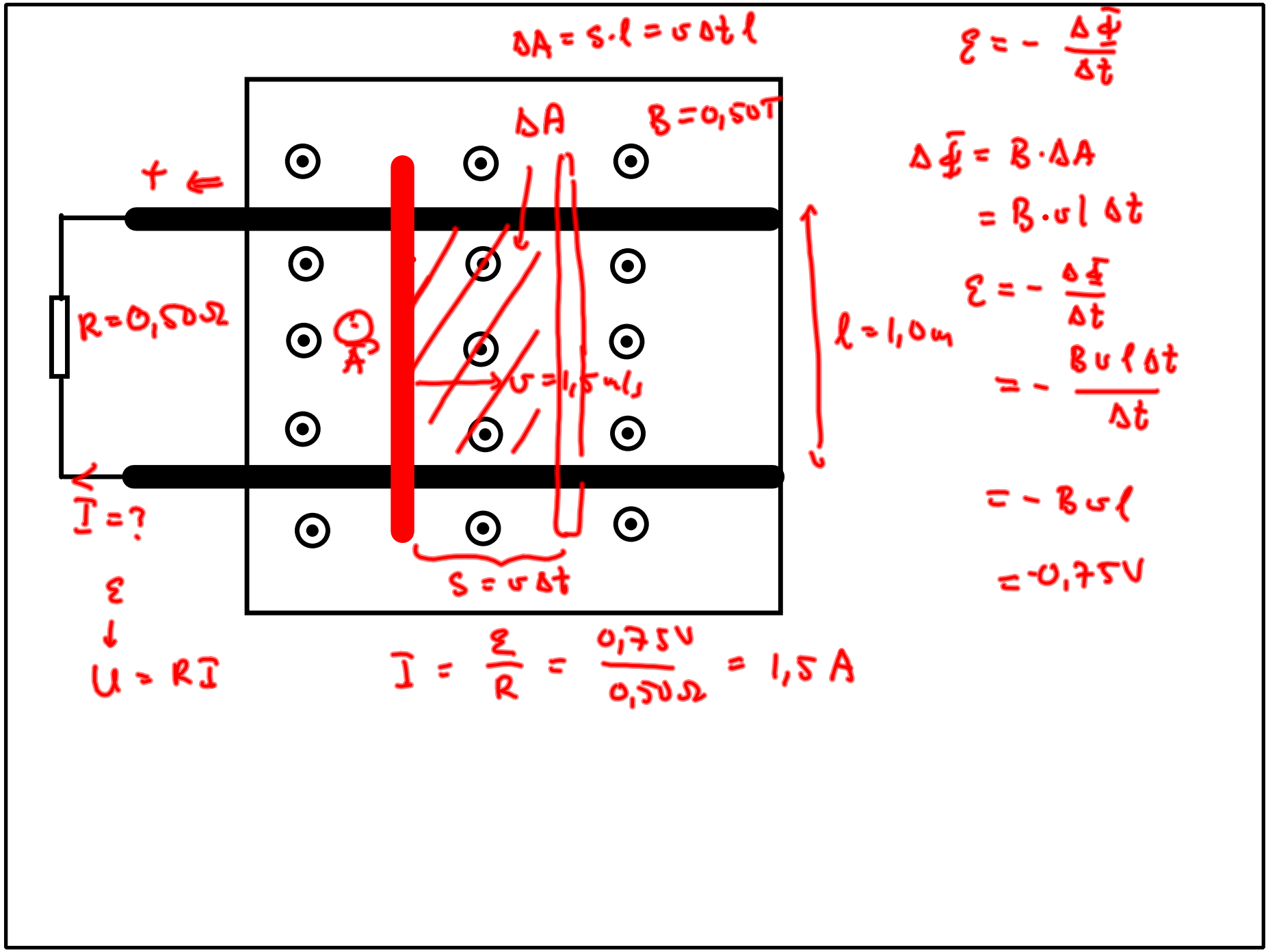
C: $\Delta \Phi = -0{,}3$ Wb

$\Delta t = 2{,}0$ s

$\mathcal{E} = -100\frac{-0{,}3\text{ Wb}}{2{,}0\text{ s}} = 15$ V

Lag en graf som viser ems som funksjon av tid




ΔA = s · l = v Δt l
ε = − ΔΦ / Δt
ΔA
B = 0,50 T
B
+
R = 0,50 Ω
R
I = ?
I
v = 1,5 m/s
v
l = 1,0 m
l
s = v Δt
s
ΔΦ = B · ΔA
= B · v l Δt
ε = − ΔΦ / Δt
= − B v l Δt / Δt
= − B v l
= − 0,75 V
ε
U = R I
I = ε / R = 0,75 V / 0,50 Ω = 1,5 A

Generator

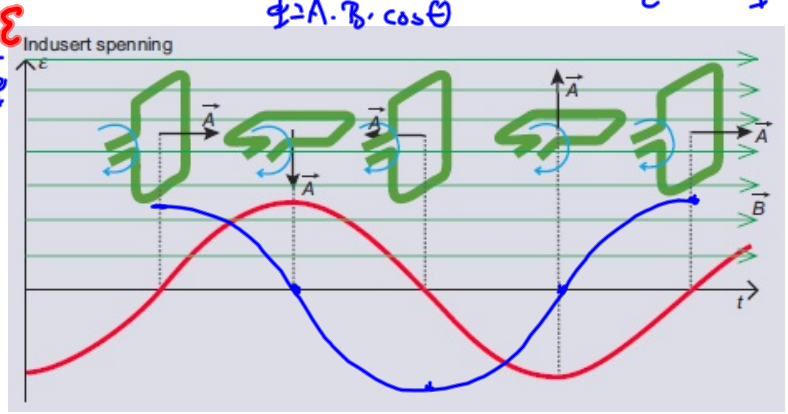
Φ_0 ωt

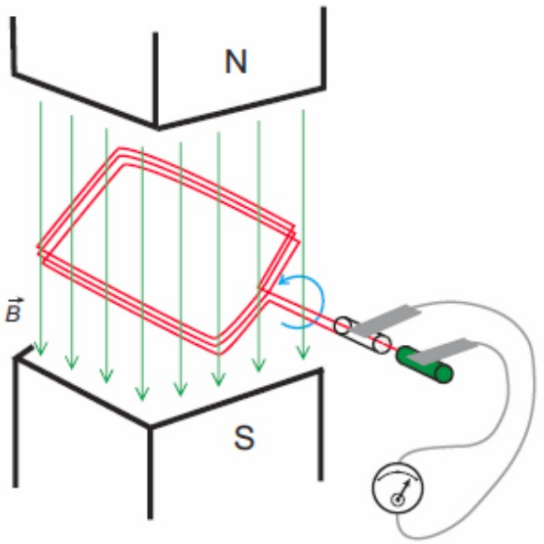
$\Phi = \vec{A} \cdot \vec{B} \cdot \cos\Theta$

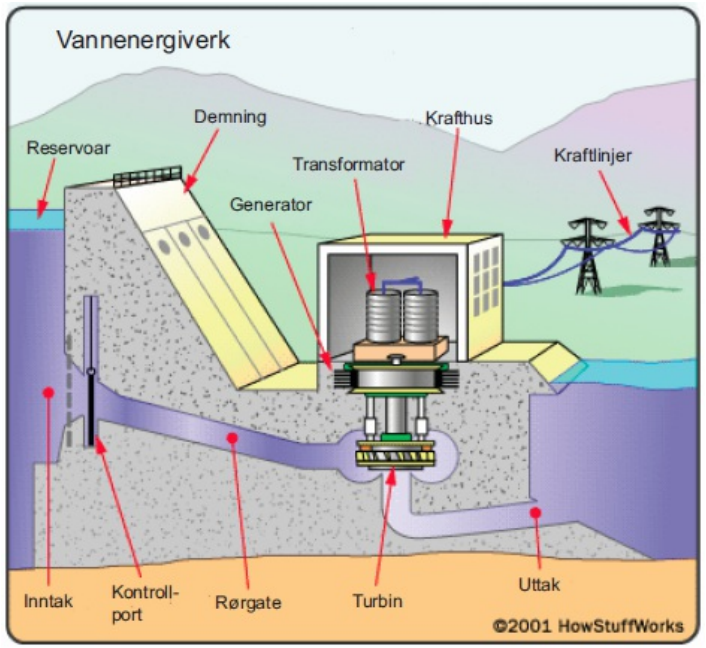
$\mathcal{E} = -\Phi'(t) = -(\Phi_0 \cos \omega t)'$

$= \Phi_0 \omega \sin \omega t$

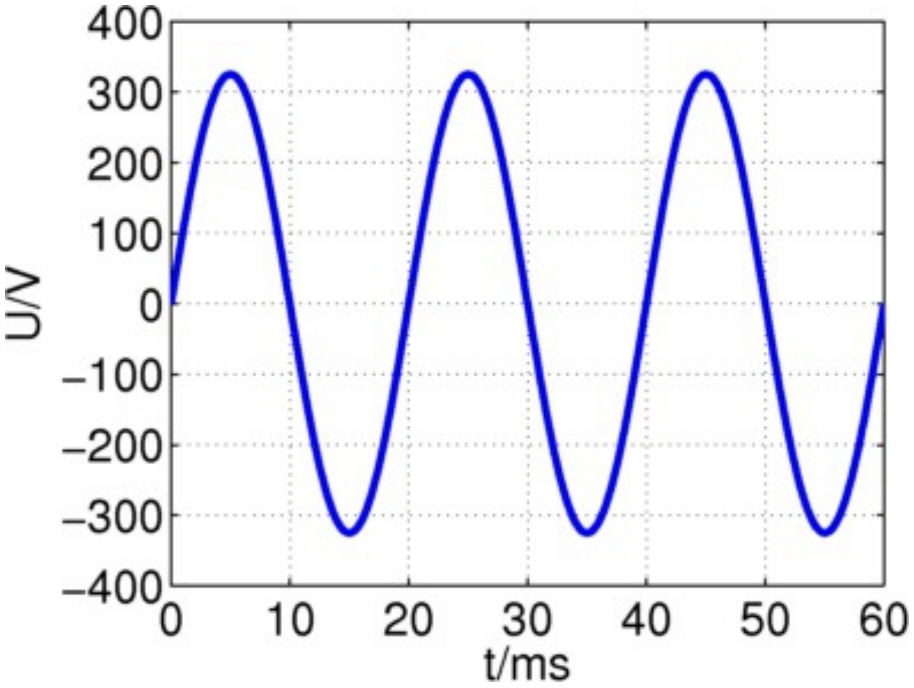
$= \mathcal{E}_m \sin \omega t$







Vekselstrøm



Grafisk framstilling av spenningen i stikkontakten.

Hva er frekvensen?

Hva blir funksjonsuttrykket?

Er spenningen 230 V?

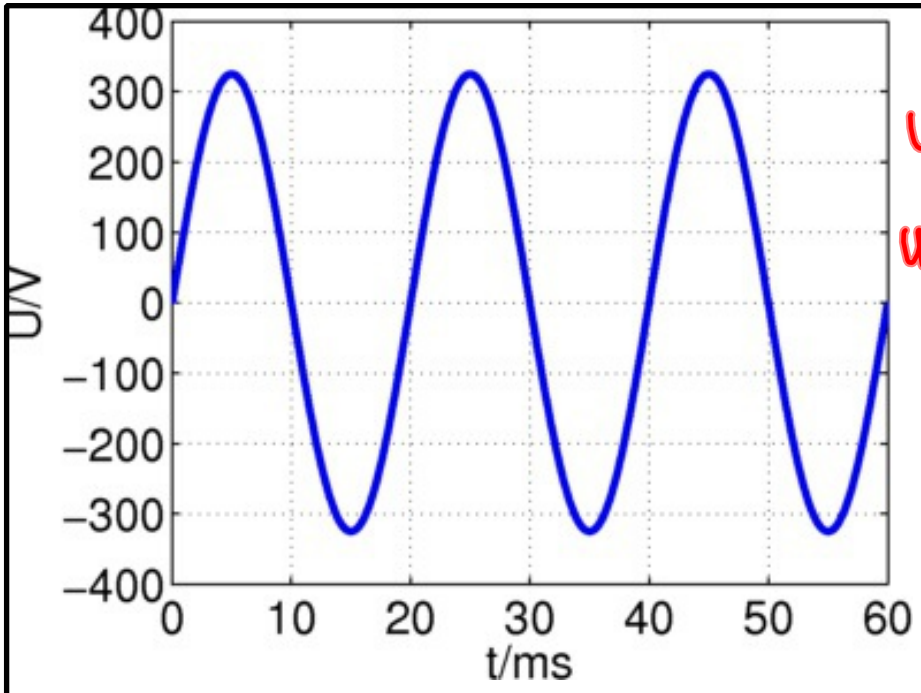
$T = 20\ ms = 20 \cdot 10^{-3}\ s$

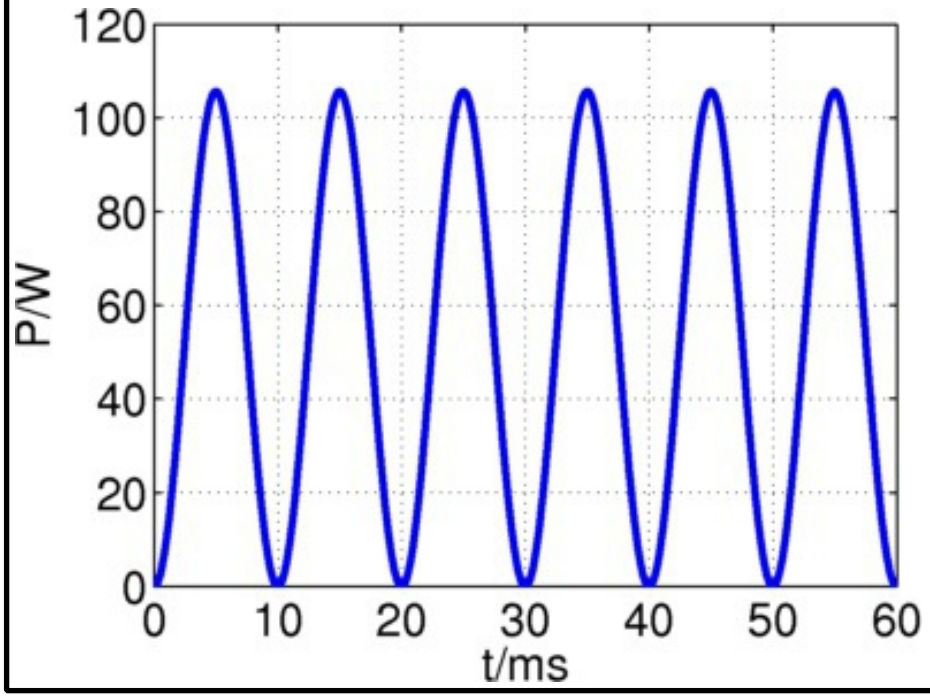
$f = \frac{1}{T} = \frac{1}{20 \cdot 10^{-3}\ s} = 50\ \frac{1}{s} = 50\ Hz$

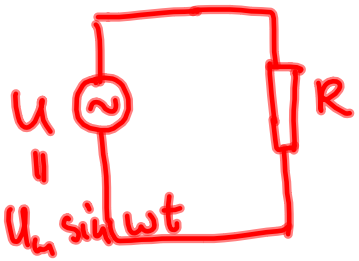
$u = u_m \sin \omega t$

u_m: 325 V

ω: $2\pi f = 314\ rad/s$







$I = \frac{U}{R}$

$P = U \cdot I$

$= \frac{U^2}{R}$

$= \frac{U_m^2}{R} \cdot \sin^2 \omega t$

$\overline{P} = \frac{U_m^2}{R} \underbrace{\overline{\sin^2 \omega t}}_{\frac{1}{2}} = \frac{1}{2} \cdot \frac{U_m^2}{R}$

$= \frac{(U_m/\sqrt{2})^2}{R} = \frac{U_e^2}{R}$

$U_e = \frac{U_m}{\sqrt{2}} = \frac{325V}{\sqrt{2}} = 230V$