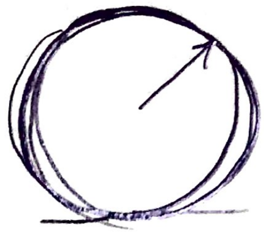
13.24



$N = 50$ turns

$r = 0.075m$

$B_i = 0.50T$

Find induced EMF

a) ... if $B_f = 0$ in $\Delta t = 0.10s$.

$$\mathcal{E} = -N\frac{d\Phi_B}{dt} = (50 \text{ turns})\left(\frac{\Delta B}{\Delta t}\right)(A)$$

$$= 50\left(\frac{0-0.50T}{0.10s}\right)\pi(0.075m)^2$$

$$= \boxed{4.42V}$$

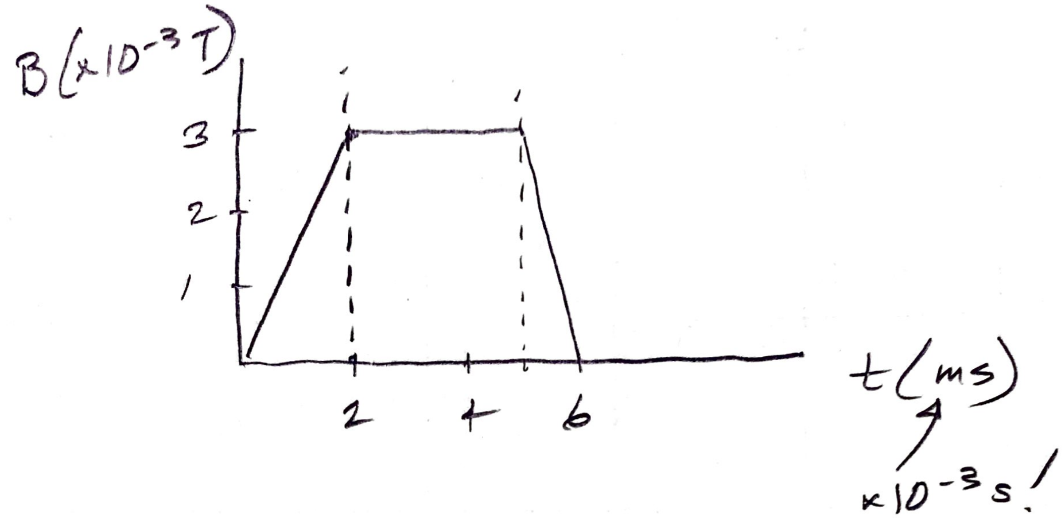
b) if $B_f = 0$ in $\Delta t = 1.0s$

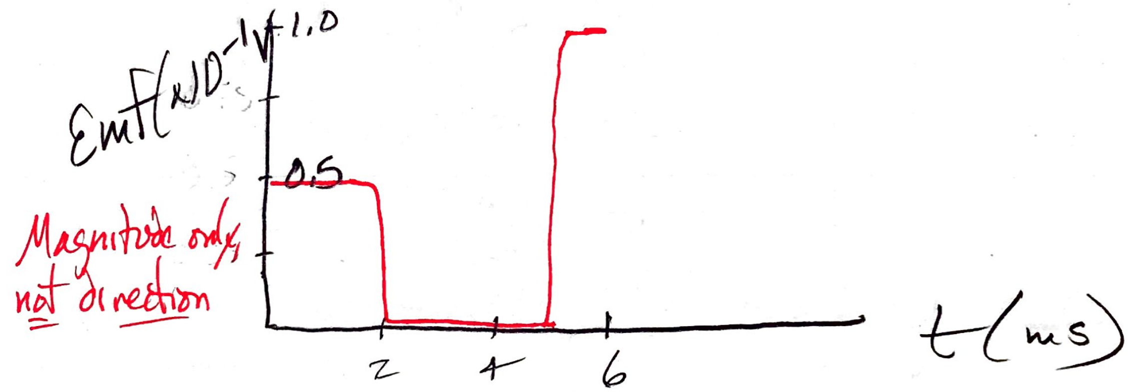
$\mathcal{E} = -N\frac{d\Phi_B}{dt}$. Same calc as above, but Δt bigger so $\mathcal{E}$ smaller (proportionally).

$$\boxed{0.442V}$$

c) ... in $\Delta t = 60s$ $\quad \frac{V}{\Delta t} = \frac{0.442}{60} = \boxed{0.00736V}$

13.27 Magnetic field through circular loop ($r = 0.10\,m$) varies according to graph. Plot induced emf as function of time.





In general, $\mathcal{E} = -\frac{d\Phi_B}{dt} = -\frac{dB}{dt}A$

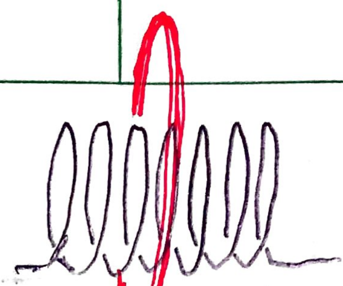
$\Delta t = 2 - 0\,s \quad = \left(\frac{3-0}{2-0}\right)\pi(0.10)^2 = 0.047\ V$

$\Delta t = 5 - 2\,s \quad = \frac{dB}{dt} = 0, \text{ so } = 0.\ V$

$\Delta t = 6 - 5\,s \quad = \frac{3-0}{6-5}\pi(0.10)^2 = 0.094\ V$ (opposite!)

Magnitude

13.30



coil with 5 turns around solenoid.

solenoid, $= n = \frac{10 \text{ turns}}{0.01\,m} = \frac{1000 \text{ turns}}{m}$.

$I = 0.25A$, $A = 5\,cm^2 \times \frac{(1m)^2}{(100cm)^2} = 5e{-}4\,m^2$

careful!

When solenoid turned off, B drops to 0 in $\Delta t = 0.050s$.

$\mathcal{E}$ induced = ?

$$\mathcal{E} = -N\frac{d\Phi_B}{dt} = -N\frac{dB}{dt}A$$

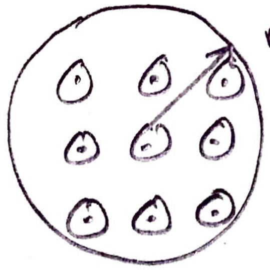
$B_{solenoid} = \mu_0 n I$, so

$$\mathcal{E} = -N\frac{\Delta \mu_0 n I}{\Delta t}A$$

$$= 5 \text{ turns}\,\frac{(4\pi e{-}7)(1000)(0.25A)(5e{-}4m^2)}{0.050s}$$

$$\mathcal{E} = \boxed{1.57e{-}5\,V}$$

13.33



$r = 50\text{ mm} = 0.050\text{ m}$

$\Delta t = 0.10\text{ s}$

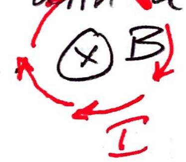
$\Delta B = 300 - 200\text{ mT}$
$= 100\text{ mT} = 0.100\text{ T}$

a) emf induced $\mathcal{E} = -\frac{d\Phi_B}{dt} = \frac{\Delta B}{\Delta t}A$

$$= \frac{(0.100\text{T})}{(0.10\text{s})}\pi(0.050\text{m})^2$$

$$= \boxed{0.00786\text{ V}}$$

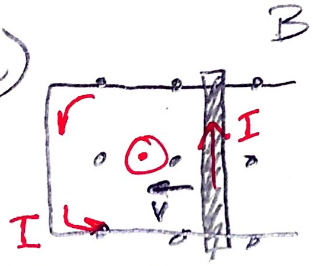
b) B is increasing out of page.
Lenz's Law predicts a current with a B field that opposes that change.



So induced current is <u>clockwise</u>.

13.36

a)

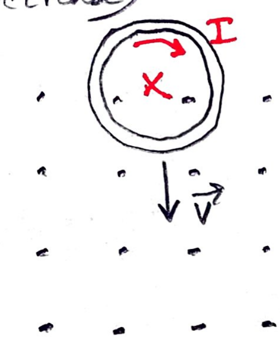


B out of page & flux decreasing, so induced emf has current w/ B in same direction (opposing decrease)

b)

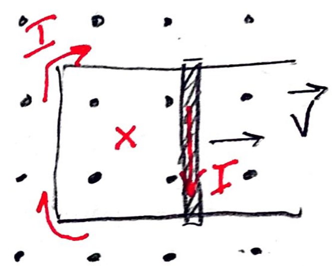
As conducting loop leaves field, flux decreases, so emf has current w/ B in same direction

c)



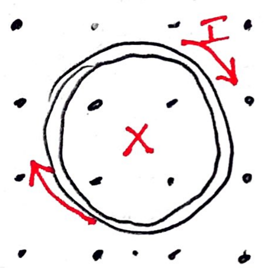
As conducting loop enters field, flux increases, so induced current has B field in opposite direction.

d)



Flux increasing, so induced current has B field in opposite direction.

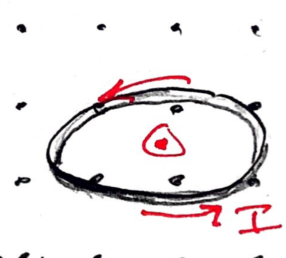
e)



B increasing

As flux increases, induced current has B field in opposite direction.

f)



B decreasing

As flux decreases, B from induced current is in same direction.