14.29

Mutual inductance = changing flux in one area affects emf in another area

Mutual inductance of coil 2 from coil 1 = M_{21}

$$M_{21} = \frac{N_2 \Phi_2}{I_1}$$

For this problem, emf $\mathcal{E} = 9.7e\text{-}3V$ due to mutual inductance with nearby coil where $\frac{\partial I}{\partial t} = 2.7A/s$.

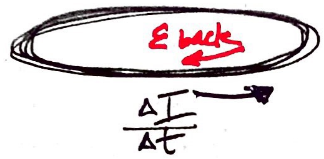
We don't have information about coils specifically, but we do know $\mathcal{E} = -L\frac{\partial I}{\partial t}$

$$L = \frac{\mathcal{E}}{\partial I/\partial t} = \frac{9.7e\text{-}3V}{2.7A} = \boxed{3.59e\text{-}3H}$$

14.35

Emf = 0.40V induced in a coil when current changes: $\frac{\Delta I}{\Delta t} = \frac{I_f - I_i}{\Delta t} = \frac{0.60 - 0.10\,A}{0.30\,s} = 1.67\,A/s$

$$L = -\frac{\mathcal{E}}{\Delta I/\Delta t} = \frac{0.40\,V}{1.67\,A/s} = \boxed{0.24\,H}$$

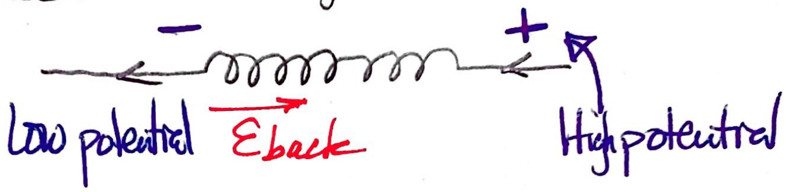


14.36

I increasing

a) Which end of inductor has higher potential?

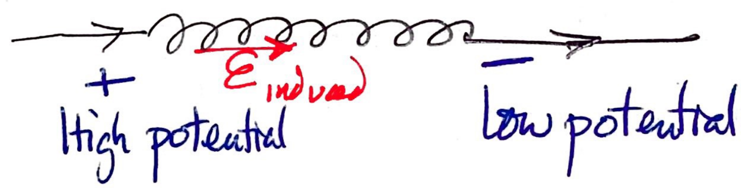
Inductor opposes change in current. If current is increasing, Emf is pushing against that increase. Still original $\mathcal{E}$ dominates, so



b)

I decreasing

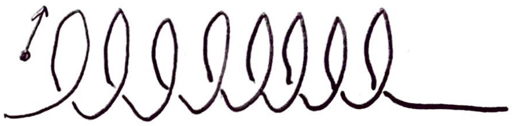
Here, inductor opposes decrease in current (& flux) w/ an Emf in the same direction as the original. Therefore:



14.43 $n = 100 \text{ turns/cm} \times \frac{100\text{ cm}}{1\text{ m}} = \underline{1.0e4 \text{ turns/m}}$

$r = 1.5\text{cm}$

$= \underline{1.5e-2\text{m}}$



a). Find inductance per unit length

Reviewing derivation: $B_{sol} = \mu_0 n I$

$\mathcal{E} = -L\frac{dI}{dt} = -N\frac{d\Phi_B}{dt}$

$L\cancel{I} = B \cdot A = \mu_0 n \cancel{I} A N$

$L = \mu_0 n A N = (4\pi e\text{-}7)(1.0e4 \tfrac{\text{turns}}{m})(\pi(1.5e\text{-}2)^2)(10{,}000 \text{ turns})$

$L = \boxed{8.88e-2\,H}$ (per meter)

b) If $\frac{dI}{dt} = 5A/s$, $\mathcal{E}$ induced $= ?$

$\mathcal{E} = -L\frac{dI}{dt}$

$= (8.88e-2H)(5\,A/s)$

$\mathcal{E}_{induced} = \boxed{0.444\,V}$ (per meter)