phys 341 class 34

infinite solenoid: $B = \mu_0 N I$ ← inside (N = see text: turns per meter)

$= 0$ ← outside

B2.pdf: $\vec{A} = \begin{cases} \mu_0 N I \frac{r}{2} \hat{\phi} & \text{for } r \le R \\ \frac{\mu_0 N I R^2}{2r} \hat{\phi} & \text{for } r \ge R \end{cases}$

check: p 603 – cylindrical – $\nabla \times$ – for $A_\phi(r)$ only

$\nabla \times A = \hat{k} \frac{1}{r} (\partial_r (r A_\phi))$ if $A = \frac{B}{2} r \Rightarrow B \hat{k}$

if $A = \frac{BR^2}{2r} \Rightarrow 0 \hat{k}$

Eq 12-11 $U = \frac{1}{2} \frac{\Phi^2}{L} \leftarrow L I$

per length

$\mu_0 N I \cdot N \cdot \pi r^2$ (B; N turns; area)

$= \frac{1}{2} L I^2 = \frac{1}{2} \mu_0 N^2 \pi r^2 I^2$

$= \frac{1}{2\mu_0} B^2 \pi r^2$ (energy/volume; total volume $= \pi r^2 l$)

12-13b $U = \frac{1}{2} \int K \, dA \cdot \mu_0 N I \frac{R}{2} = \frac{1}{2\mu_0} (\mu_0 N I)^2 \pi R^2$ ✓

($K = NI$; $dA = 2\pi R l$; $\frac{R}{2} = \bar{A}$ on surface)

12-15 $U = \frac{1}{2\mu_0} B^2 \cdot \text{Volume}$ ← we've converted all of above to this form