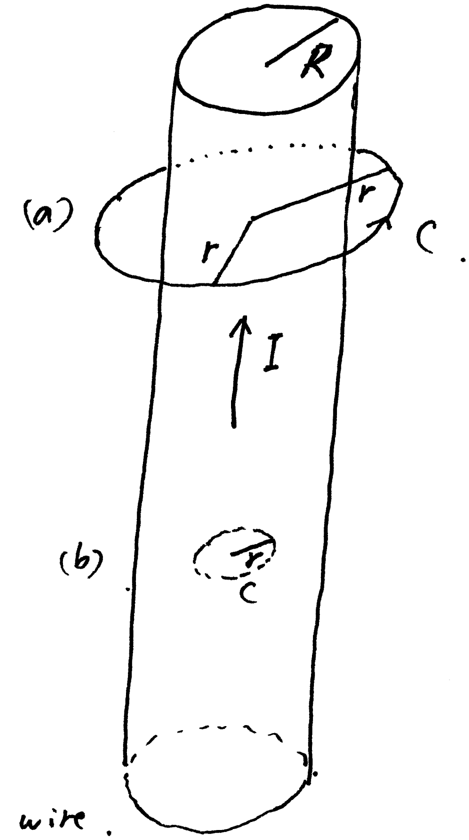
e.g. 28-6. Uniform current in a cylindrical long wire.

Current density: (current per unit crossectional area).

Ampere's law: $\Sigma \vec{B}\cdot\Delta\vec{\ell} = \mu_0 I_{encl.}$



a). outside. $r > R$.

choose a closed path C. — circle.

at any point on C: $\vec{B} \parallel \Delta\vec{\ell}$

$B = \text{const}$.

$\therefore \quad \Sigma \vec{B}\cdot\Delta\vec{\ell} = \Sigma B\Delta\ell = B\Sigma\Delta\ell = B\cdot 2\pi r$.

$B\, 2\pi r = \mu_0 I_{encl.} = \mu_0 I$.

$B = \dfrac{\mu_0 I}{2\pi r}$. — same as a thin wire.

b). Inside.

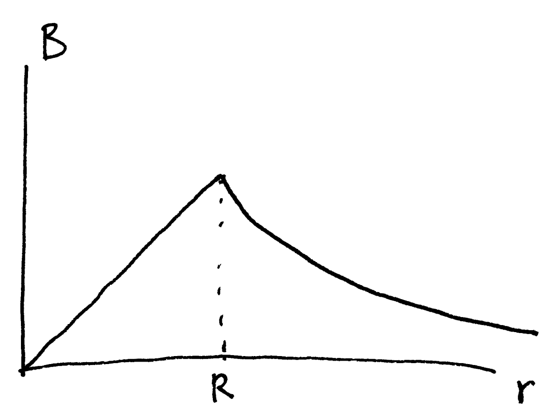
$\Sigma \vec{B}\cdot\Delta\vec{\ell} = \mu_0 I_{encl.}$

$B\cdot 2\pi r = \mu_0 \left(\dfrac{I}{\pi R^2}\right)\cdot \pi r^2$.

(current density: $\dfrac{I}{\pi R^2}$.
(current per unit crossectional area))

$B = \dfrac{\mu_0 I r}{2\pi R^2}$.

Direction of $\vec{B}$: RHR.



c). plug in numbers