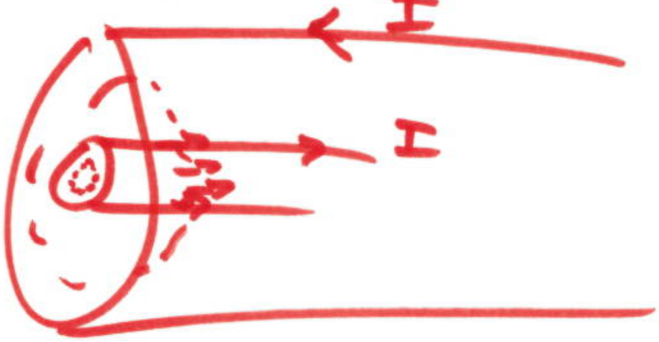
Day 19

Quiz 3: Ampere's Law
Quiz 3 Solution



Exam 2 this Friday

Review: Tues. Apr 3rd 5-6pm SIE 2111

$\boxed{r<a}$

$$\oint \vec{B}\cdot d\vec{l} = \mu_0 I_{IN}$$

$I_{IN} = 0$

$\boxed{B = 0}$

$a < r < b$

I_{IN}: I

$$\oint \vec{B}\cdot d\vec{l} = \mu_0 I$$

$$B\, 2\pi r = \mu_0 I$$

$$\boxed{B = \frac{\mu_0 I}{2\pi r}}$$

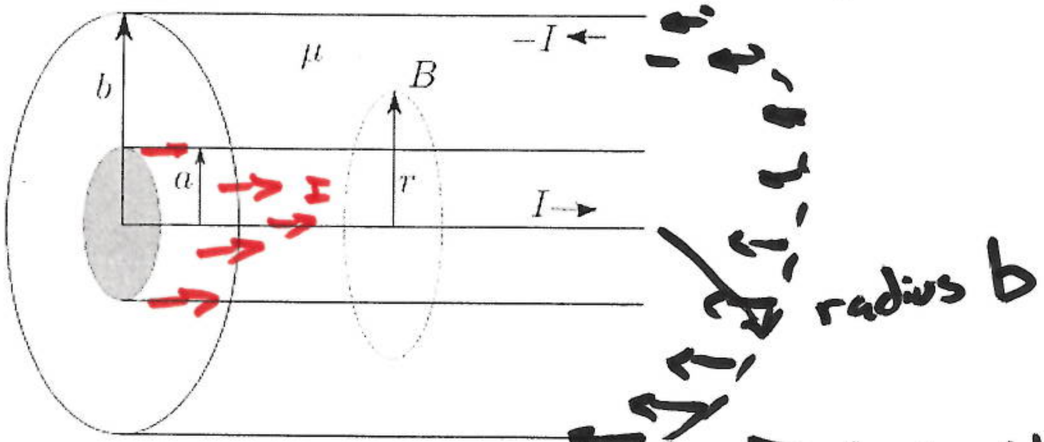
$r > b$ outside

$I_{IN} = 0$

$\boxed{B = 0}$

Spring 2018 Physics 201 Quiz 3.0: Ampere's Law Write Name Front and Back!

Find the Magnetic field as a function of radius in and outside a coaxial cable. The cable has two hollow cylinders, radius a and b as shown below. Equal currents, I, travel to the right on the inner shell, and to the left on the outer shell. There are three region: r<a, a<r<b, and r>b. Find the magnetic field as a function of radius, r, in each region, in terms of radius r, current I and any constants.



also I, but other way

Circumference of circle $2\pi r$ Area of circle: πr^2

Ampere's Law $\oint \vec{B}\cdot\vec{dl} = \mu_0 I_i$

3.B. $\vec{F}$ direction

(i) $q>0$

$\vec{v}$

$\vec{B}$

$\vec{F}$ out of page

$\vec{F} = q\vec{v}\times\vec{B}$ $\quad F = qvB\sin\theta$

(ii) $q>0$

$\vec{v}$

$\vec{B}$ INTO

$\vec{F}$ up

(iii) $q<0$

$\vec{v}$

$\vec{B}$

No Direction

$\vec{F}=0$

(iv) $q<0$

$\vec{v}$

$\vec{F}$

INTO

$\vec{B}$

Note: $\vec{v}\times\vec{B}$ points ↘ but $q<0$ which flips direction to ↖.

(v) $q>0$

$\vec{v}$

$\vec{B}$

$\vec{F}$ out of page

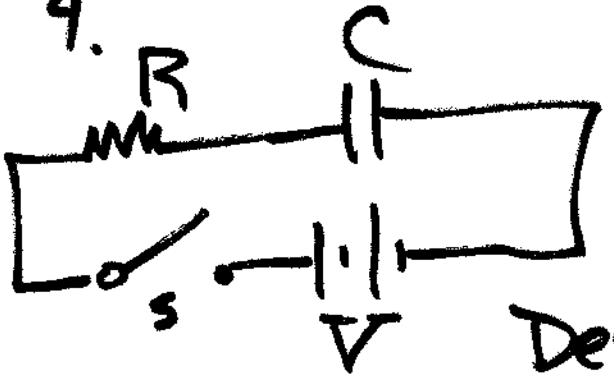
(vi) $q=0$

$\vec{v}$

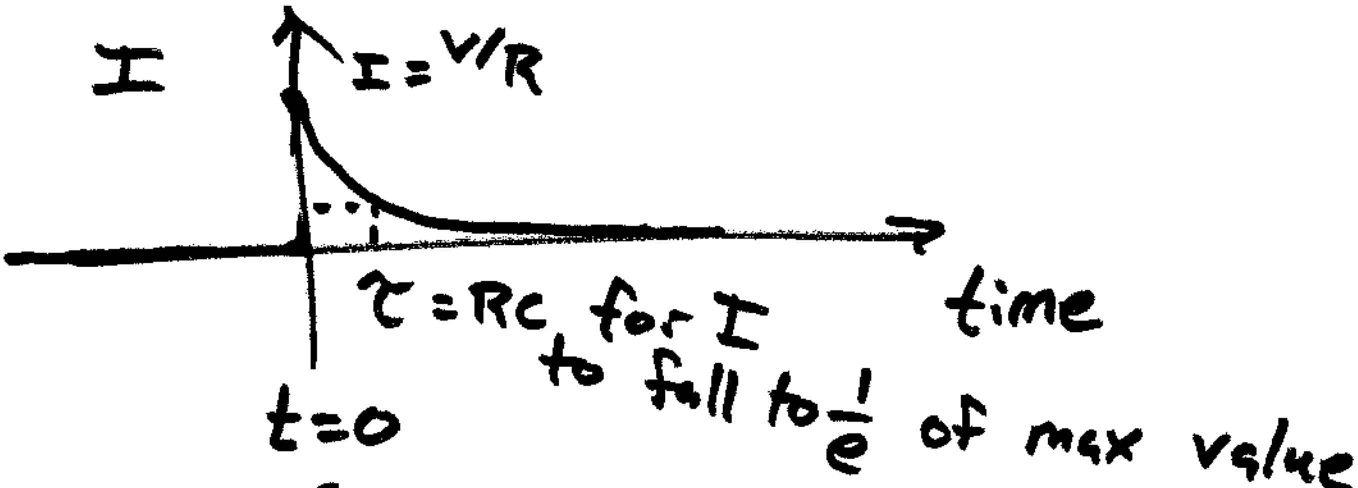
$\vec{B}$

$\vec{F}=0$ Nö Direction

4.

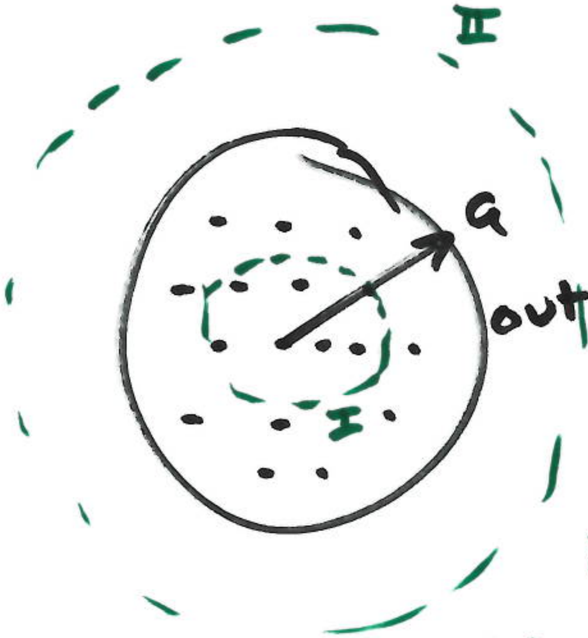


at $t=0$,
switch closes.
C is init. uncharged.
Describe I vs. time
words, equ, or graph.



$$I(t) = \begin{cases} 0 & t<0 \\ \frac{V}{R} e^{-t/\tau} & t>0 \end{cases}$$

(5.) Find $B(r)$ inside and outside solid wire radius a carrying total I uniformly distributed throughout its area.



$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{IN}$$

(I) $r<a$ (inside)

(II) $r>a$ (outside).

(II) $I_{IN} = I$

in (I) $I_{IN} = J \cdot \text{area}$

$$J = \frac{I}{\pi a^2} = \frac{\text{total } I}{\text{total area wire}}$$

in (I) $I_{IN} = J\,(\pi r^2) = \dfrac{I}{\cancel{\pi} a^2} \cdot \cancel{\pi} r^2$

$$I_{IN} = I \frac{r^2}{a^2} \quad (r<a)$$

in (II) $I_{IN} = J \pi a^2$ but $J = \dfrac{I}{\pi a^2}$

thus $I_{IN} = \dfrac{I}{\pi a^2} \cdot \pi a^2 = I$ ✓ yay

$$\left.\begin{aligned} \oint \vec{B} \cdot \vec{d\ell} &= \mu_0 I_{IN} \\ B\, 2\pi r &= \mu_0 I_{IN} \end{aligned}\right\} \text{cylinder}$$

$$B = \frac{\mu_0 I_{IN}}{2\pi r}$$