5.10 Which of the following is a statement of charge conservation?

A) $\frac{\partial \rho}{\partial t} = -\nabla \vec{\mathbf{J}}$

B) $\frac{\partial \rho}{\partial t} = -\nabla \bullet \vec{\mathbf{J}}$

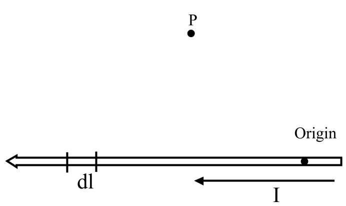
C) $\frac{\partial \rho}{\partial t} = -\iiint (\nabla \bullet \vec{\mathbf{J}})\, d\tau$

D) $\frac{\partial \rho}{\partial t} = -\oiint \vec{\mathbf{J}} \bullet d\vec{\mathbf{A}}$

E) Not sure

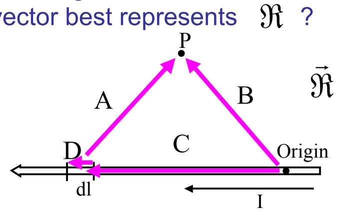
5.11 To find the magnetic field B at P due to a current-carrying wire we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$

In the figure, with "dl" shown, what is $\vec{\mathfrak{R}}$?



5.11 To find the magnetic field B at P due to a current-carrying wire we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$

In the figure, with "dl" shown, which purple vector best represents $\vec{\mathfrak{R}}$?



$\vec{\mathfrak{R}} = \vec{r} - \vec{r}\,'$

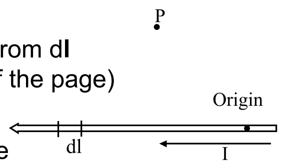
E) None of these!

5.12 To find the magnetic field B at P due to a current-carrying wire we use the Biot-Savart law,

$$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\boldsymbol{\mathscr{R}}}}{\boldsymbol{\mathscr{R}}^2}$$

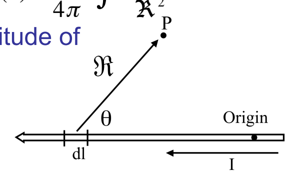
What is the *direction* of the infinitesimal contribution d**B**(P) created by current in d**l**?

A) Up the page
B) Directly away from d**l** (in the plane of the page)
C) Into the page
D) Out of the page
E) Some other direction



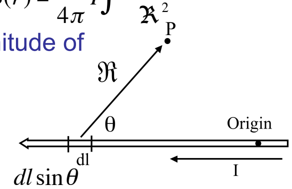
5.13 To find the magnetic field B due to a current-carrying wire, below, we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\boldsymbol{\mathscr{R}}}}{\boldsymbol{\mathscr{R}}^2}$

What is the magnitude of $\frac{d\vec{l} \times \hat{\boldsymbol{\mathscr{R}}}}{\boldsymbol{\mathscr{R}}^2}$?



5.13 To find the magnetic field B due to a current-carrying wire, below, we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\boldsymbol{\mathscr{R}}}}{\boldsymbol{\mathscr{R}}^2}$

What is the magnitude of $\frac{d\vec{l} \times \hat{\boldsymbol{\mathscr{R}}}}{\boldsymbol{\mathscr{R}}^2}$?



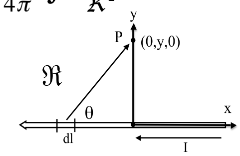
a) $\frac{dl \sin\theta}{\mathfrak{R}^2}$ b) $\frac{dl \sin\theta}{\mathfrak{R}^3}$

c) $\frac{dl \cos\theta}{\mathfrak{R}^2}$ d) $\frac{dl \cos\theta}{\mathfrak{R}^3}$ e) something else!

(And, what's $\mathfrak{R}$ here, given that P = (x,y,z)?)

5.13m To find the magnetic field B due to a current-carrying wire, below, we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$

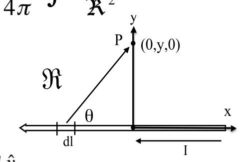
What is the value of $I \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$?



(What's $\mathfrak{R}$ here, given that P = (0,y,0)?)

5.13m To find the magnetic field B due to a current-carrying wire, below, we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$

What is the value of $I \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$?



a) $\frac{Iy\,dx'\,\hat{z}}{[(x')^2 + y^2]^{3/2}}$ b) $\frac{Ix'\,dx'\,\hat{y}}{[(x')^2 + y^2]^{3/2}}$

c) $\frac{-Ix'dx'\,\hat{y}}{[(x')^2 + y^2]^{3/2}}$ d) $\frac{-Iy\,dx'\,\hat{z}}{[(x')^2 + y^2]^{3/2}}$ e) Other!

5.14

What is B at the point shown?

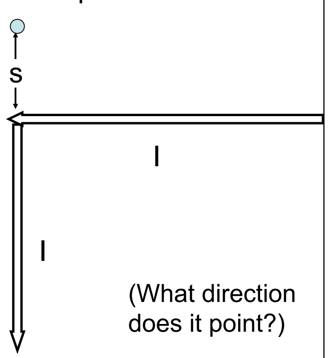
A) $\frac{\mu_0}{\pi s} I$

B) $\frac{\mu_0}{2\pi s} I$

C) $\frac{\mu_0}{4\pi s} I$

D) $\frac{\mu_0}{8\pi s} I$

E) None of these

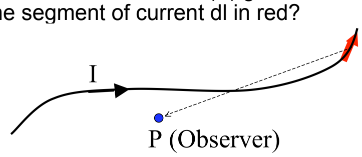


(What direction does it point?)

5.16 com

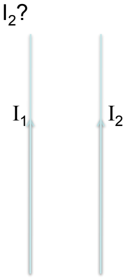
What do you expect for direction of **B**(P)?

How about direction of d**B**(P) generated JUST by the segment of current dl in red?



A) **B**(p) in plane of page, ditto for d**B**(P, by red)
B) **B**(p) into page, d**B**(P, by red) into page
C) **B**(p) into page, d**B**(P, by red) out of page
D) **B**(p) complicated - has mult component (*not* ⊥ or || to page), ditto for d**B**(P, by red)
E) Something else!!

I have two very long, parallel wires each carrying a current I_1 and I_2, respectively. In which direction is the force on the wire with the current I_2?



A) Up
B) Down
C) Right
D) Left
E) Into or out of the page

(How would your answer change if you reverse the direction of *both* currents?)

5.15

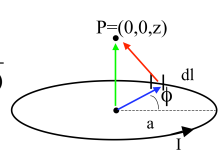
To find the magnetic field B due to a current-carrying loop, we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$

What is the magnitude of $\frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$?

A) $\frac{dl \sin\phi}{z^2}$ B) $\frac{dl}{z^2}$

C) $\frac{dl \sin\phi}{(z^2 + a^2)}$ D) $\frac{dl}{(z^2 + a^2)}$

E) Something quite different!



(Which colored arrow is $\mathfrak{R}$? **r**? **r'**?)

5.15 b

To find the magnetic field B due to a current-carrying loop, we use the Biot-Savart law, $\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} I \int \frac{d\vec{l} \times \hat{\mathfrak{R}}}{\mathfrak{R}^2}$

What is $d\mathbf{B}_z$ (the contribution to the vertical component of **B** from this dl segment?)

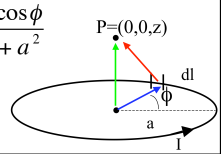
A) $\frac{dl}{z^2 + a^2} \frac{a}{\sqrt{z^2 + a^2}}$

B) $\frac{dl}{z^2 + a^2}$

C) $\frac{dl}{z^2 + a^2} \frac{z}{\sqrt{z^2 + a^2}}$

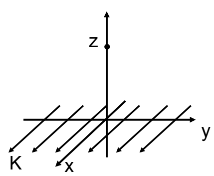
D) $\frac{dl \cos\phi}{z^2 + a^2}$

E) Something quite different!



MD10-1

Consider the B-field a distance z from a current sheet in the z = 0 plane:



The B-field has

A) y-component only
B) z-component only
C) y and z-components
D) x, y, and z-components
E) Other