Positive ions flow right through a liquid, negative ions flow left. The spatial density and speed of both ions types are identical. Is there a net current through the liquid?

A. Yes, to the right
B. Yes, to the left
C. No
D. Not enough information given

Current I flows down a wire (length L) with a square cross section (side a). If it is uniformly distributed over the entire wire area, what is the magnitude of the volume current density J?

A. $J = I/a^2$
B. $J = I/a$
C. $J = I/4a$
D. $J = a^2 I$
E. None of the above

We defined the volume current density in terms of the differential, $\mathbf{J} \equiv \dfrac{d\mathbf{I}}{da_\perp}$.

When is it ok to determine the volume current density by taking the ratio of current to cross-sectional area?

$$\mathbf{J} \stackrel{?}{=} \frac{\mathbf{I}}{A}$$

A. Never

B. Always

C. I is uniform

D. I is uniform and A is $\perp$ to I

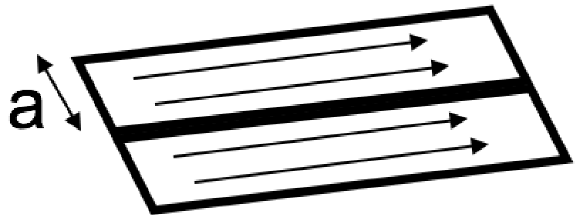
E. None of these

Current I flows down a wire (length L) with a square cross section (side a). If it is uniformly distributed over the outer surfaces only, what is the magnitude of the surface current density K?

A. $K = I/a^2$
B. $K = I/a$
C. $K = I/4a$
D. $K = aI$
E. None of the above

A "ribbon" (width a) of surface current flows (with surface current density K). Right next to it is a second identical ribbon of current. Viewed collectively, what is the new total surface current density?

A. K
B. $2K$
C. $K/2$
D. Something else



Which of the following is a statement of charge conservation?

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

B. $\frac{\partial \rho}{\partial t} = -\nabla \cdot \mathbf{J}$

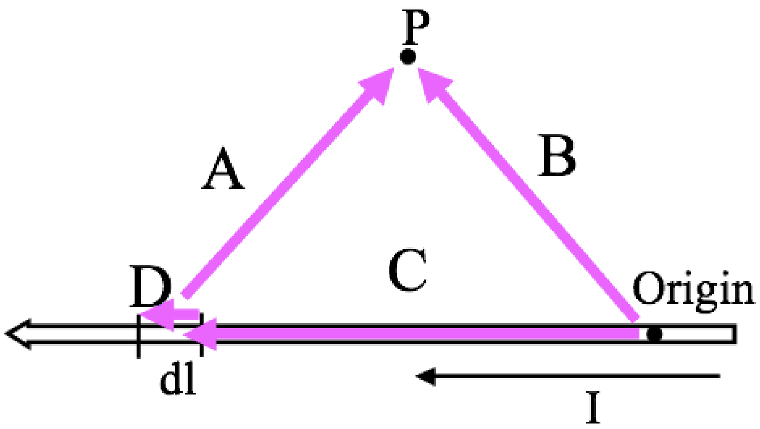
C. $\frac{\partial \rho}{\partial t} = -\int \nabla \cdot \mathbf{J} d\tau$

D. $\frac{\partial \rho}{\partial t} = -\oint \mathbf{J} \cdot d\mathbf{A}$

To find the magnetic field $\mathbf{B}$ at P due to a current-carrying wire we use the Biot-Savart law,

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

In the figure, with $d\mathbf{l}$ shown, which purple vector best represents $\mathfrak{R}$?



E) None of these!