

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

$$\text{differential, } \mathbf{J} \equiv \frac{d\mathbf{I}}{da_{\perp}}.$$

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. $K = I/a$

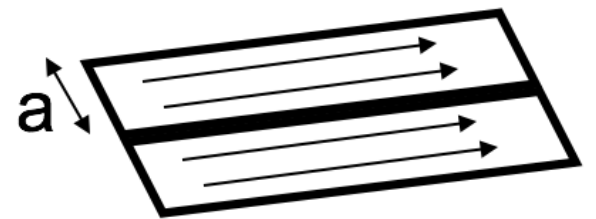
C. $K = I/4a$

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

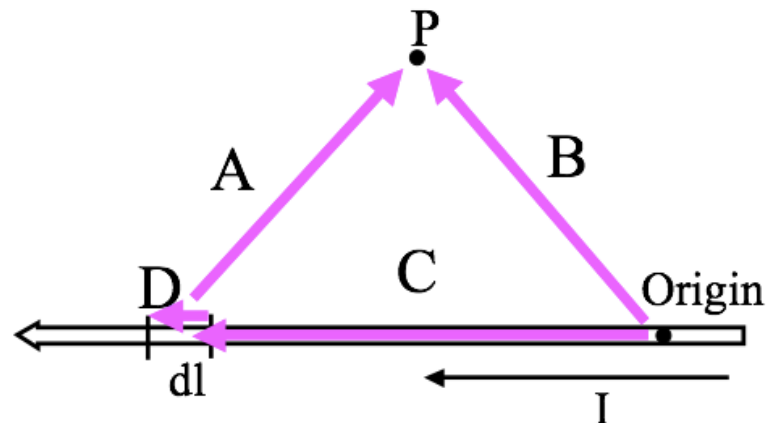
C. $\frac{\partial \rho}{\partial t} = -\int \nabla \cdot \mathbf{J} d\tau$

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,

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

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



E) None of these!