Lecture 12
Magnetism

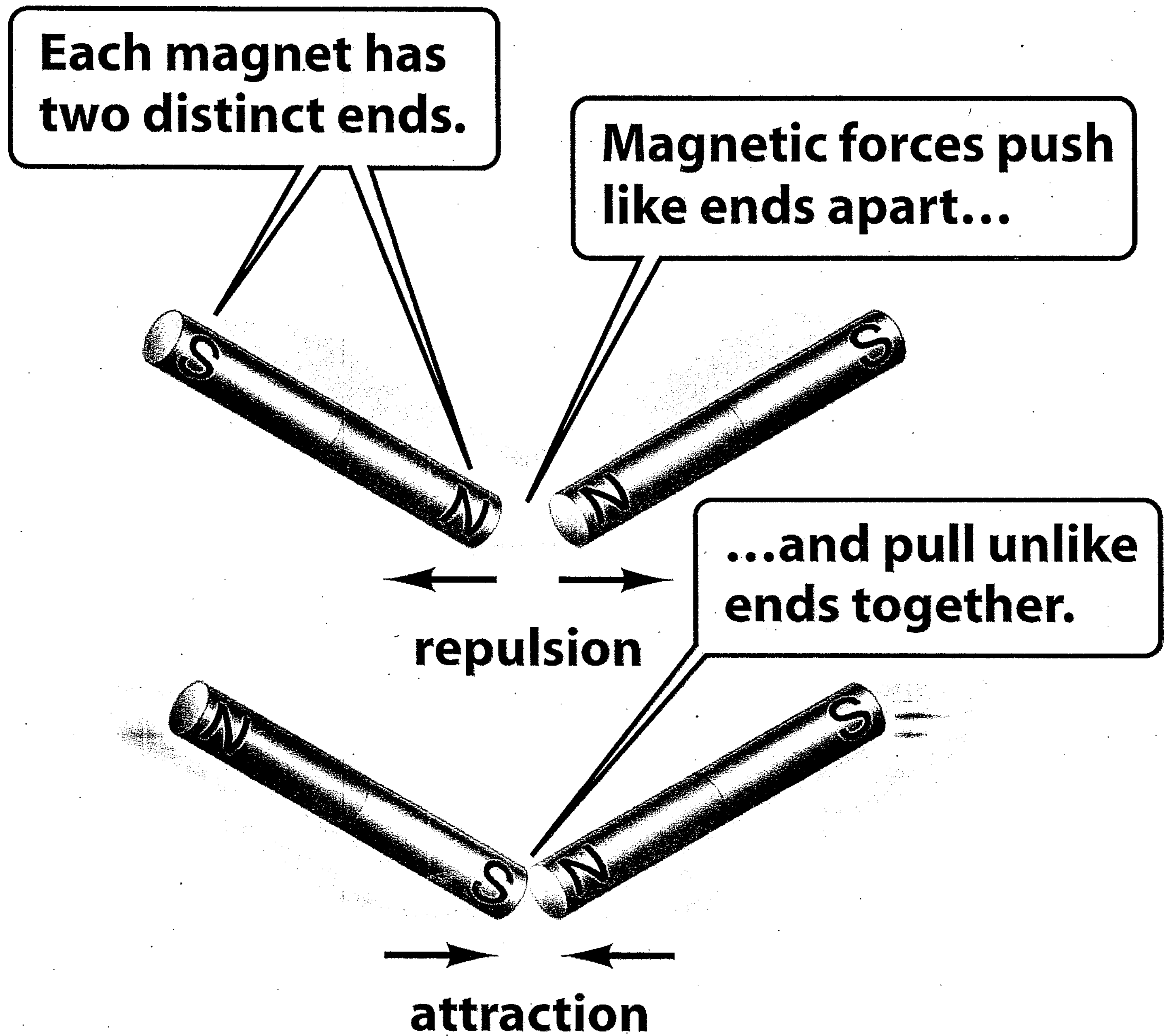


Figure 29-1 Physics for Engineers and Scientists 3/e

Magnetic south pole of Earth is near our geographic north pole.

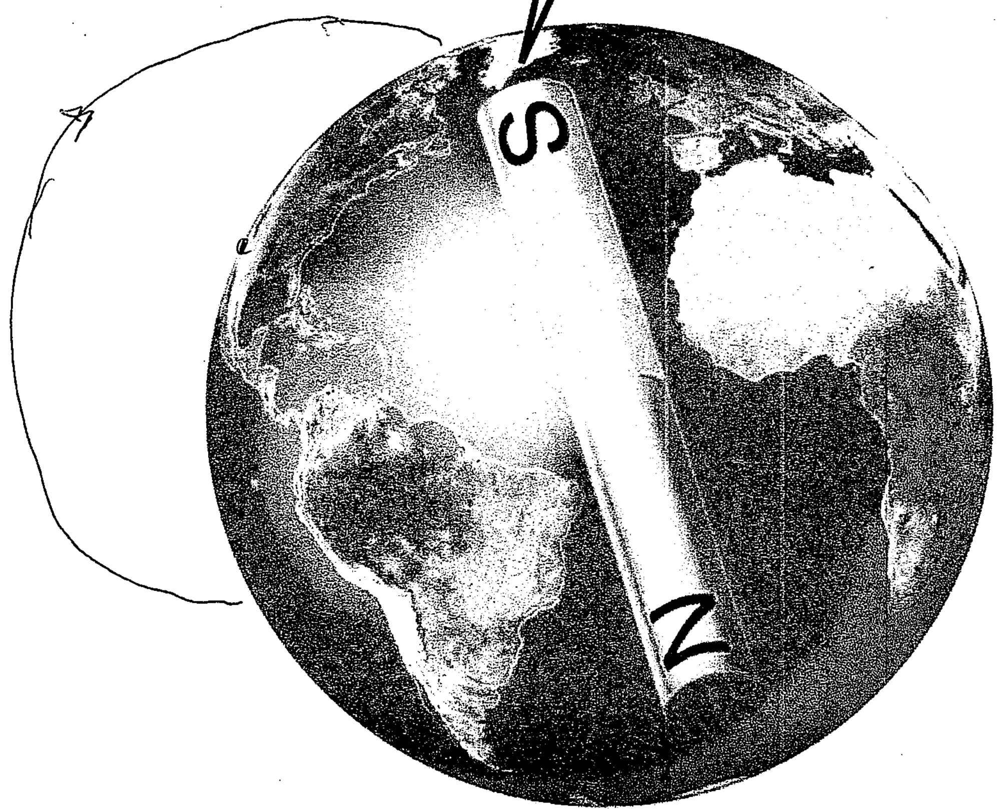


Figure 29-3 Physics for Engineers and Scientists 3/e

Which is the smallest magnet

1. an iron atom
2. ✓ an electron
3. the smallest iron <u>crystal</u> that can be fabricated

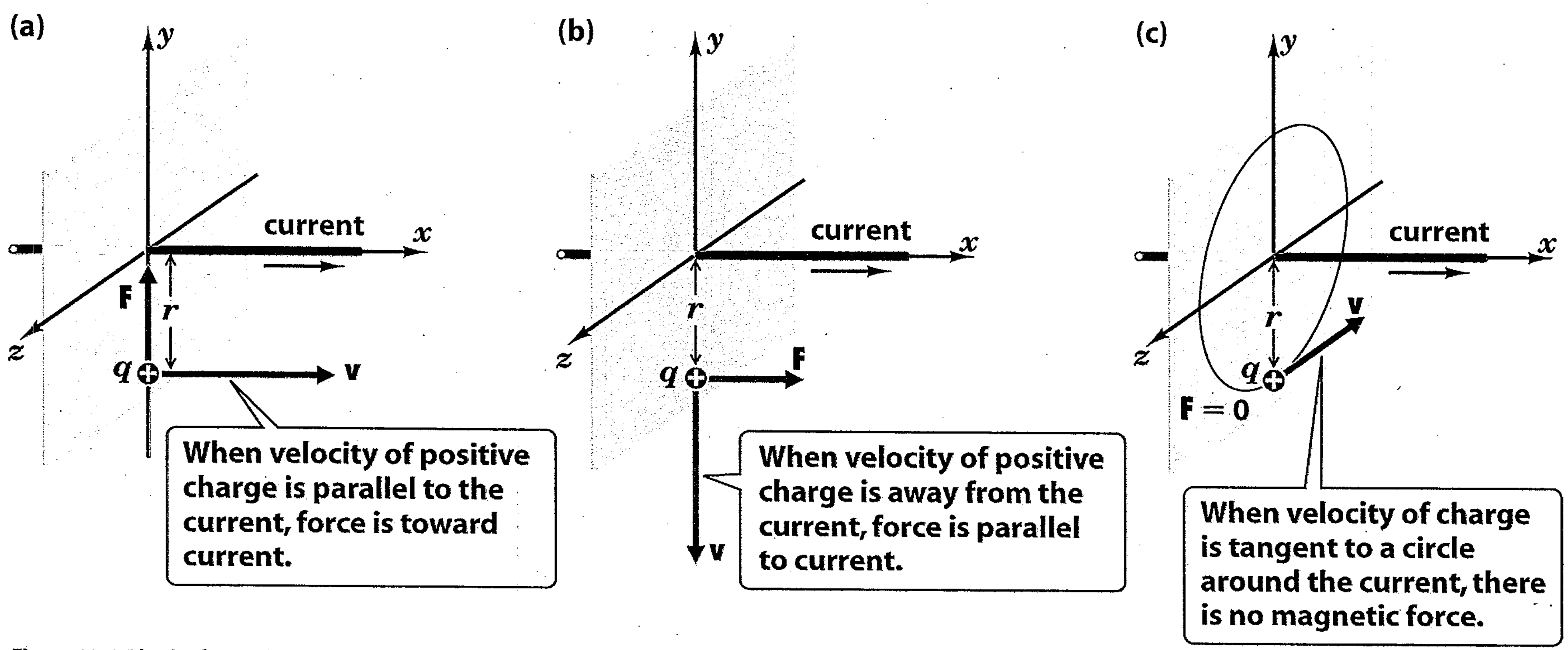


Figure 29-6 Physics for Engineers and Scientists 3/e

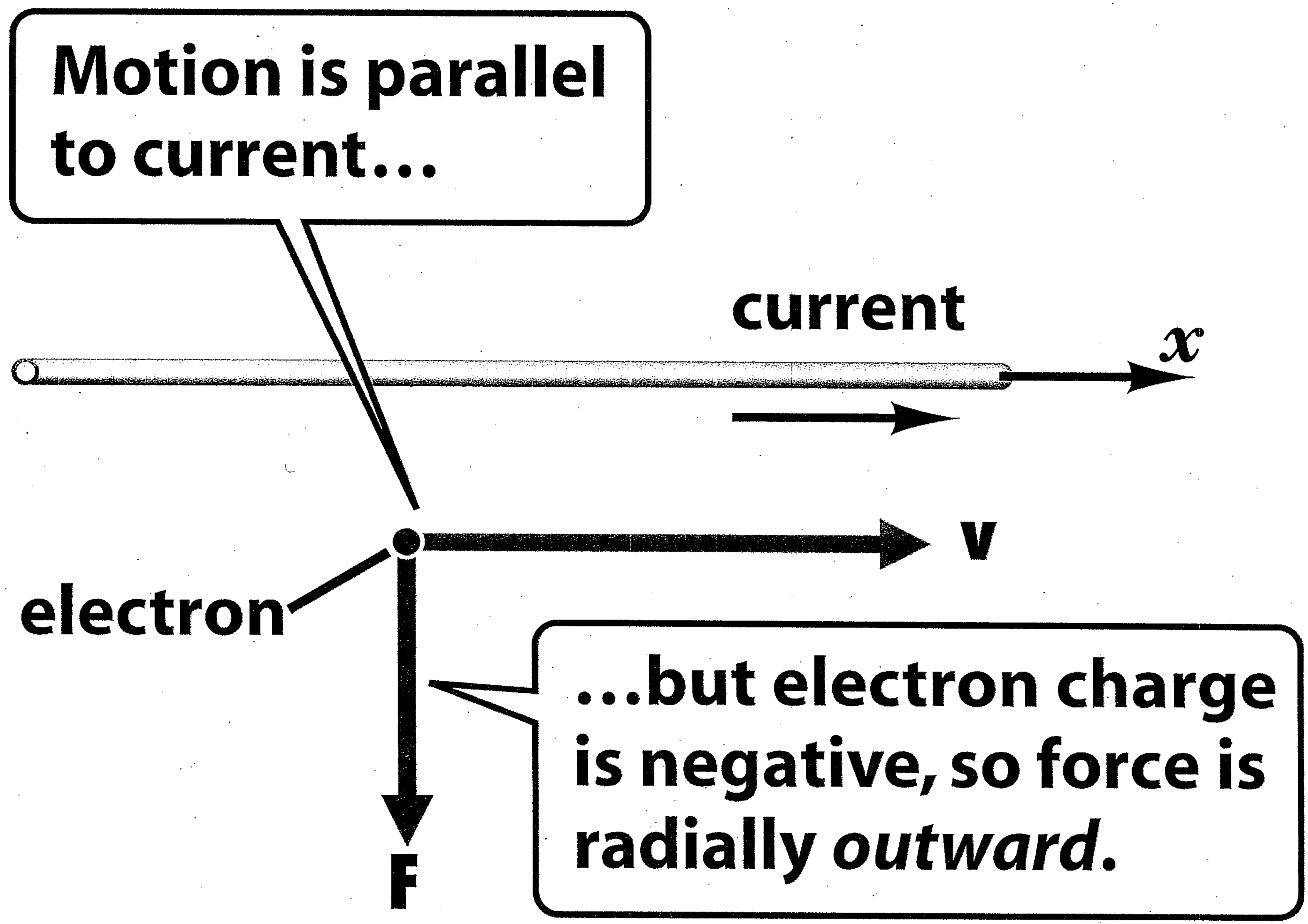


Figure 29-7 Physics for Engineers and Scientists 3/e

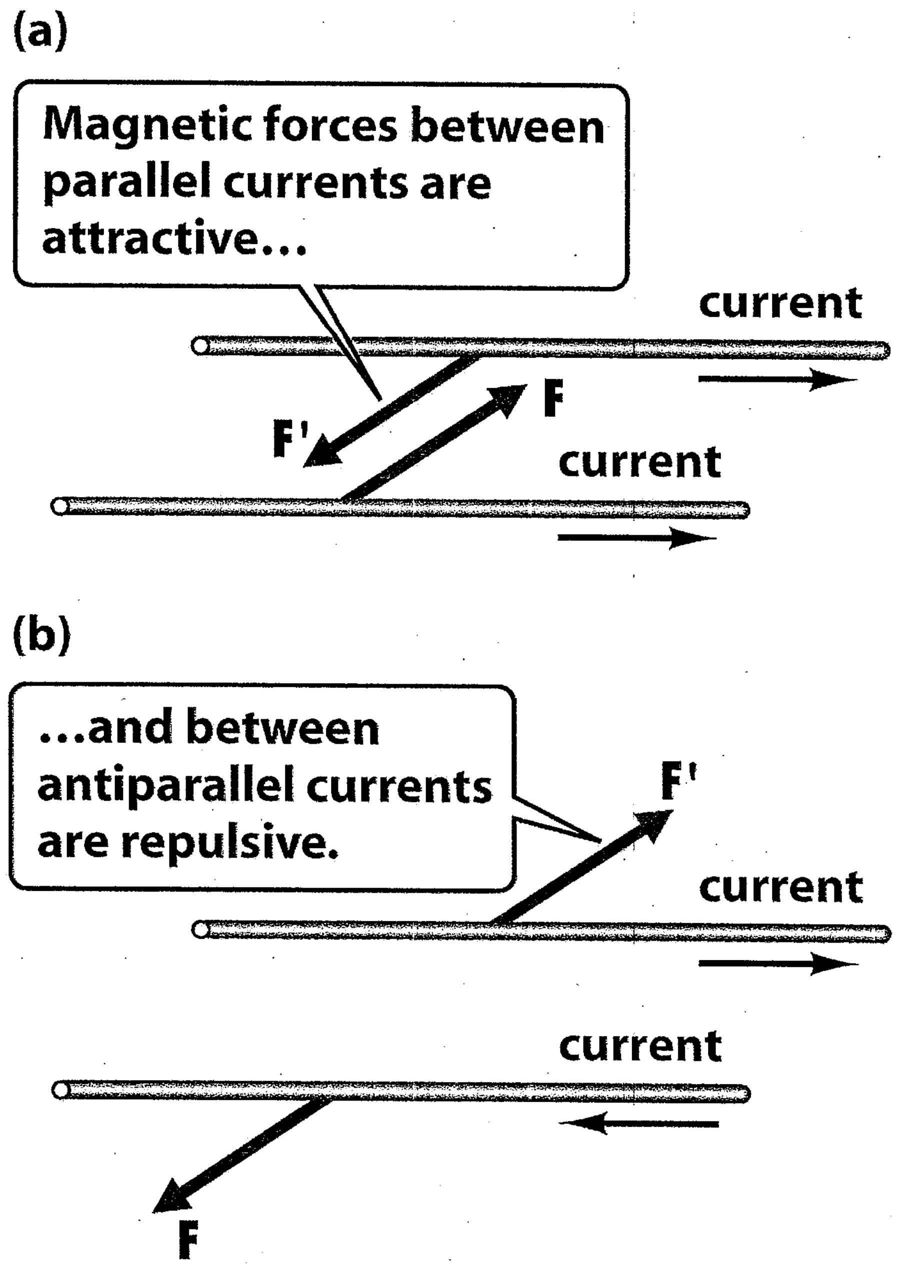


Figure 29-8 Physics for Engineers and Scientists 3/e

Electro-magnetic Force on a charge q

$$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$$

We need to review cross product relations

$$\vec{F} = q\,\vec{v} \times \vec{B} = -q\,\vec{B} \times \vec{v}$$

$$|q\,\vec{v} \times \vec{B}| = q\,|\vec{v}|\,|\vec{B}| \sin \alpha$$

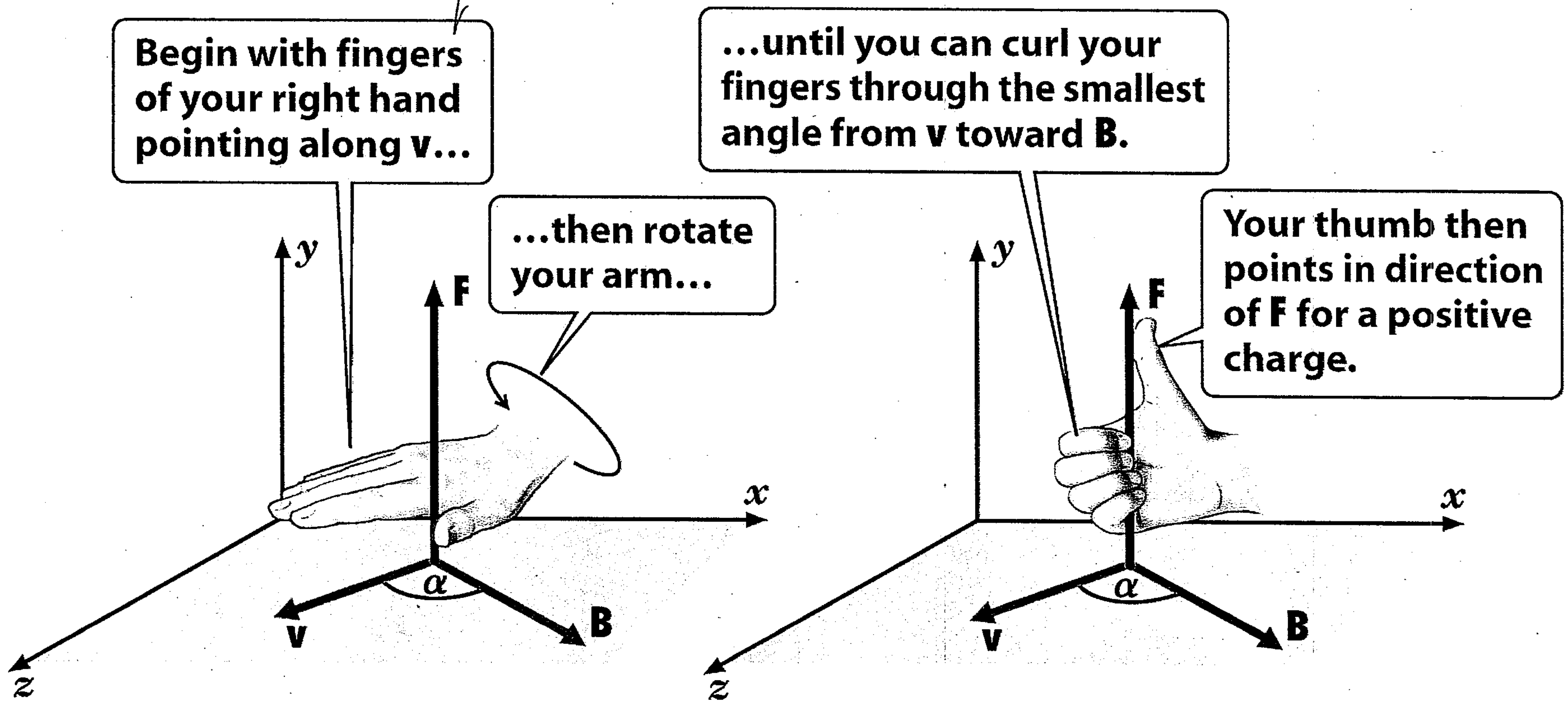


Figure 29-12 Physics for Engineers and Scientists 3/e

$\hat{x} \times \hat{y} = \hat{z}$, $\hat{y} \times \hat{z} = \hat{x}$ $\hat{z} \times \hat{x} = \hat{y}$

$\hat{y} \times \hat{x} = -\hat{z}$ $\hat{z} \times \hat{y} = -\hat{x}$ $\hat{x} \times \hat{z} = -\hat{y}$

$\vec{A} = a_x \hat{x} + a_y \hat{y} + a_z \hat{z}$; $\vec{B} = b_x \hat{x} + b_y \hat{y} + b_z \hat{z}$

If $\vec{A} = a_x \hat{x} + a_y \hat{y} + a_z \hat{z}$; $\vec{B} = b_x \hat{x} + b_y \hat{y} + b_z \hat{z}$

$$\vec{C} = \vec{B} \times \vec{A}$$

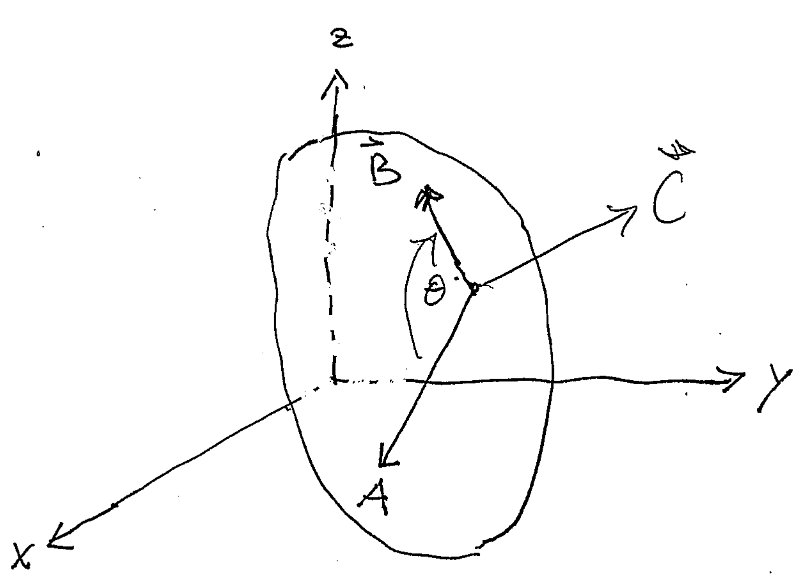
What is y-component of $\vec{C}$?

(1) $b_x a_z - b_y a_x$

(2) $b_x a_z - b_z a_x$

(3) $b_z a_x - a_z b_x$ ✓

(4) $b_z a_x - a_y b_z$



$$|\vec{C}| = |\vec{A}||\vec{B}| \sin\theta$$

Where is direction of force
(a) $\hat{z}$, (b) $-\hat{z}$ (c) $\hat{y}$ (d) $-\hat{y}$

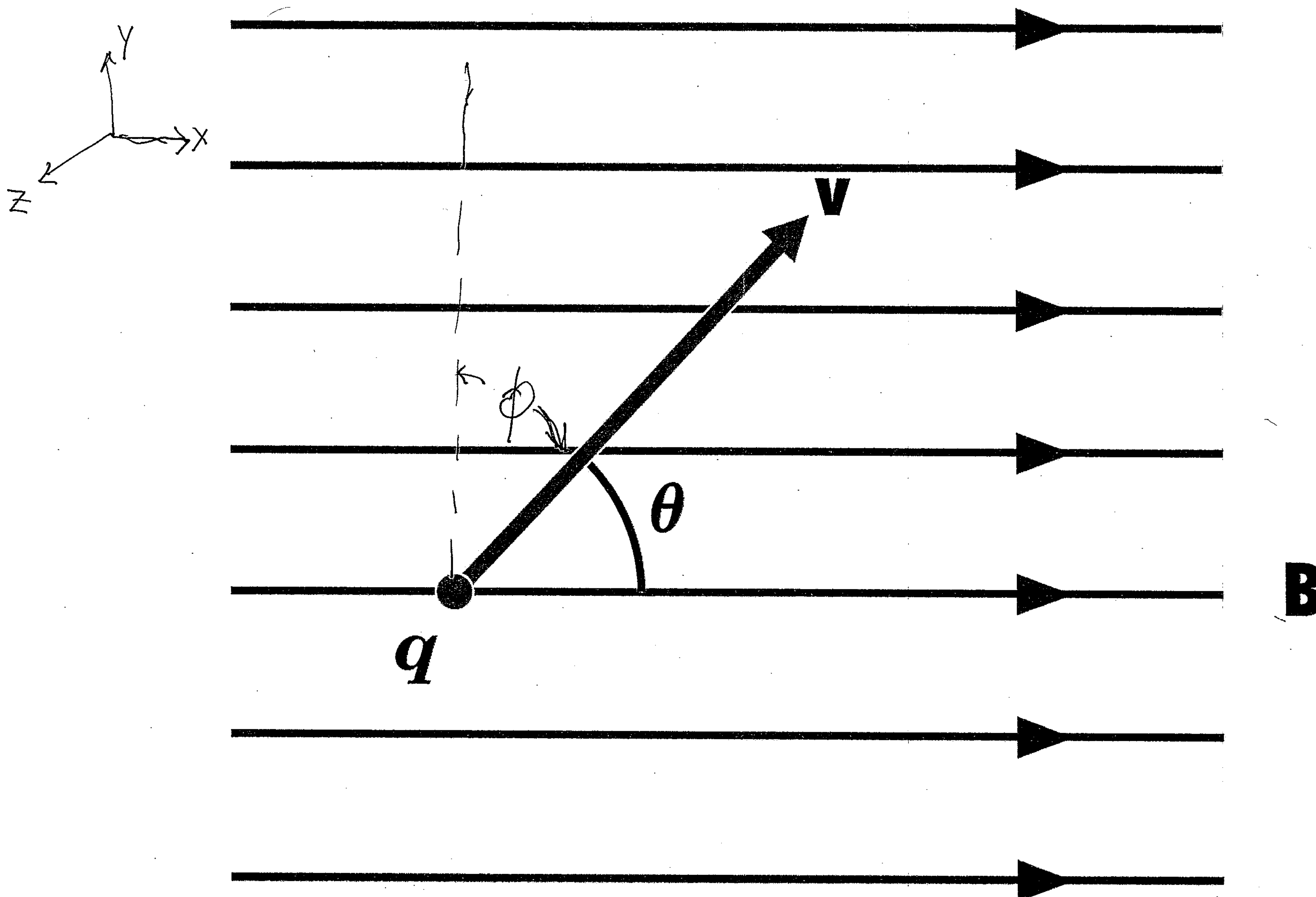
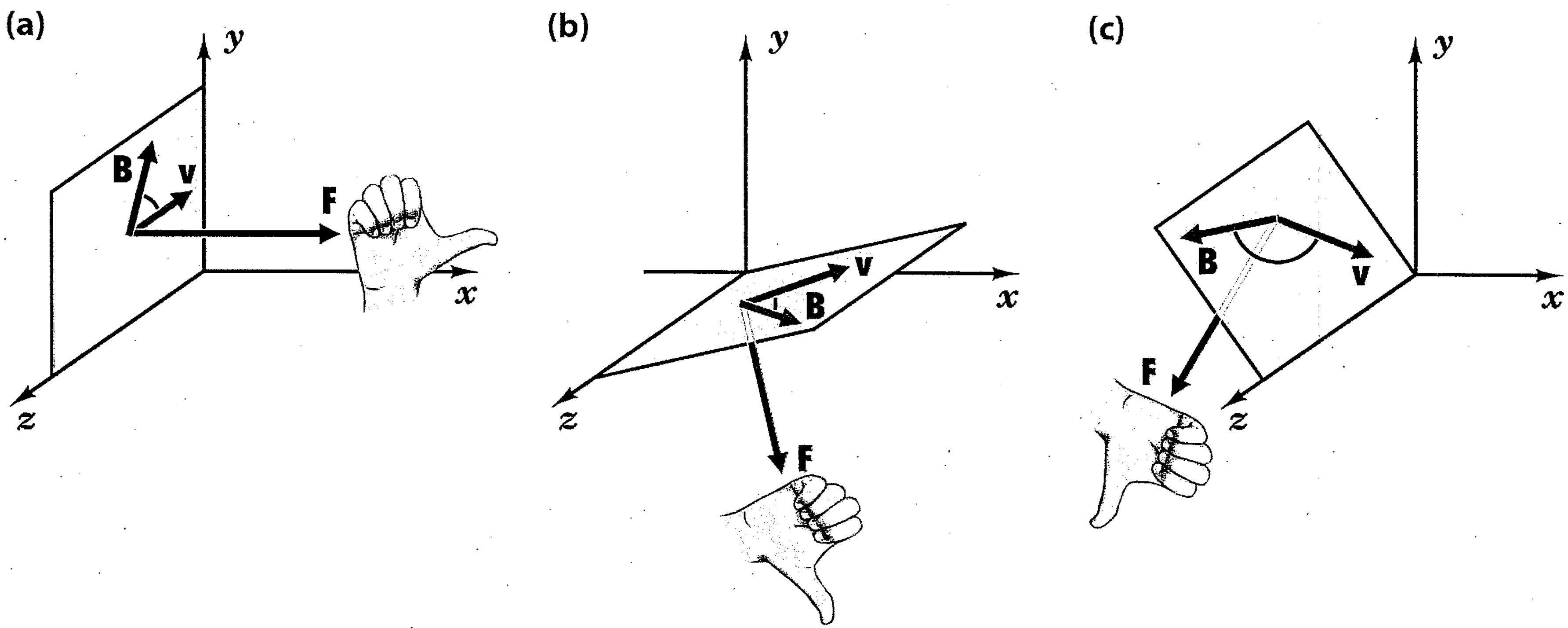


Figure 29-43 Physics for Engineers and Scientists 3/e

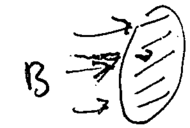
What is magnitude of force?
(a) $qvB\sin\theta$, (b) qvB (c) $qvB\cos\theta$



Unnumbered 29 pg 936 Physics for Engineers and Scientists 3/e

Magnetic Flux

$$\Phi_B = \int_{surface} \vec{B} \cdot d\vec{A}$$



Are there magnetic charges on Earth?

(1) yes

(2) no ✓

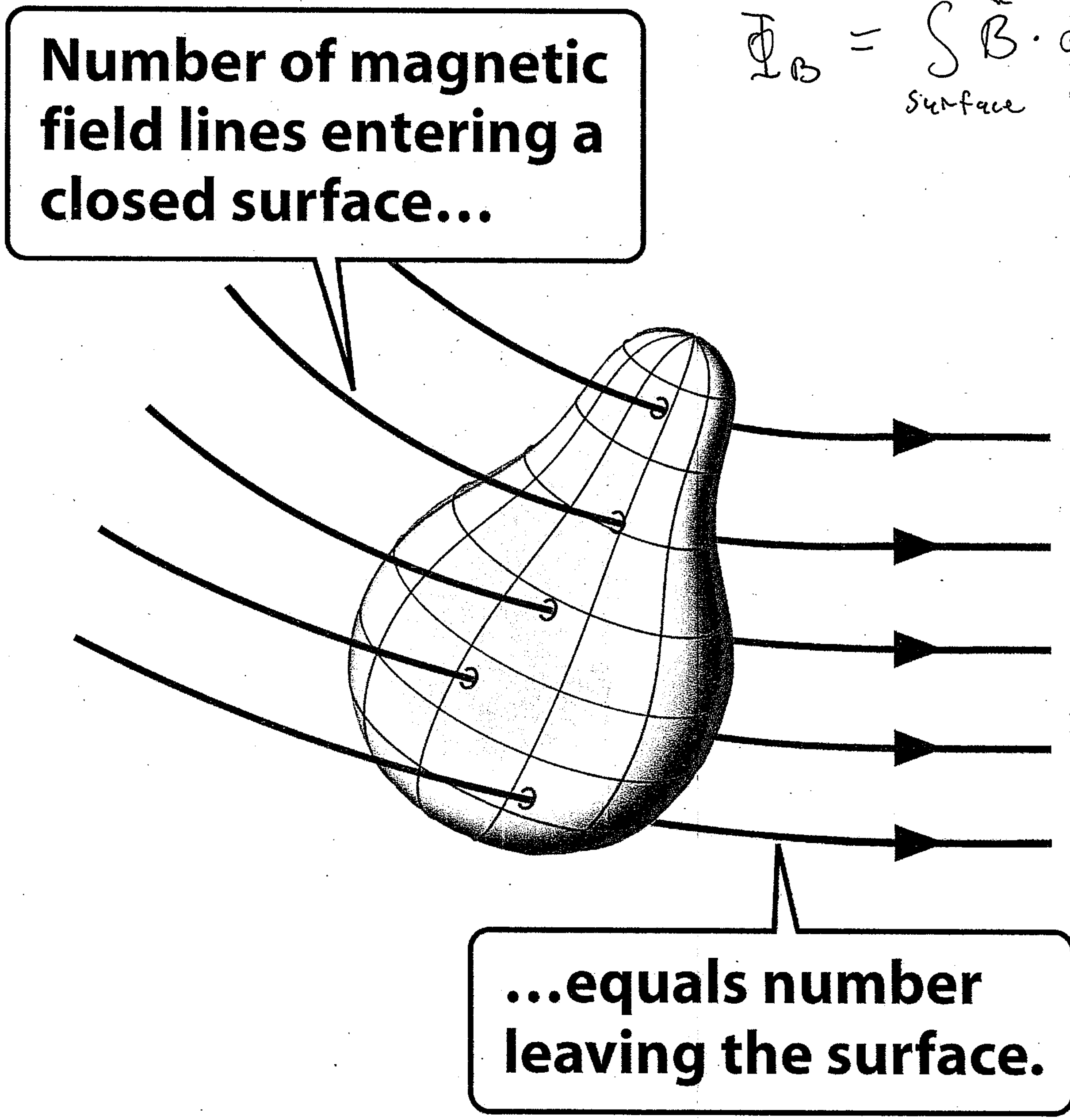


Figure 29-18 Physics for Engineers and Scientists 3/e

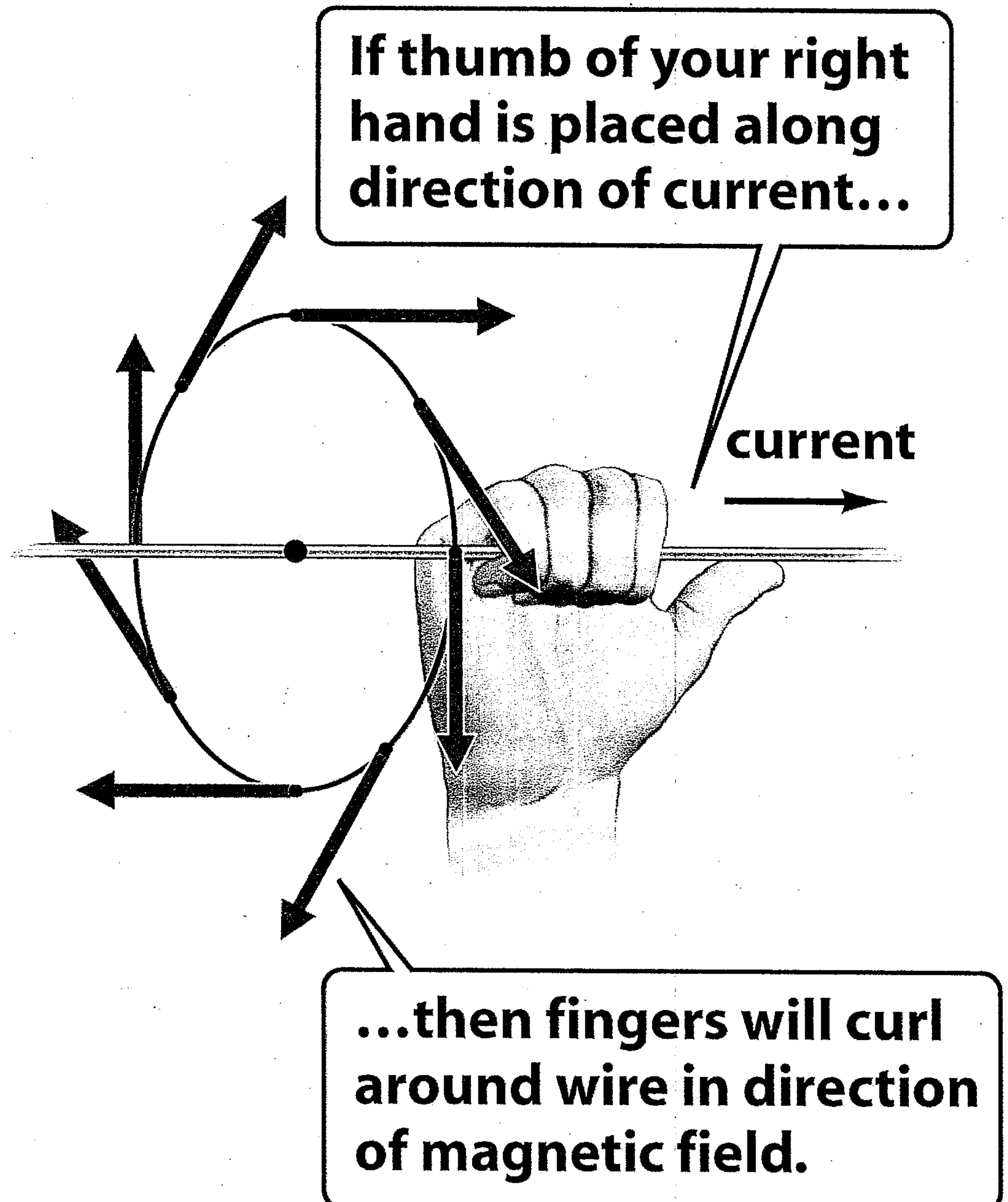
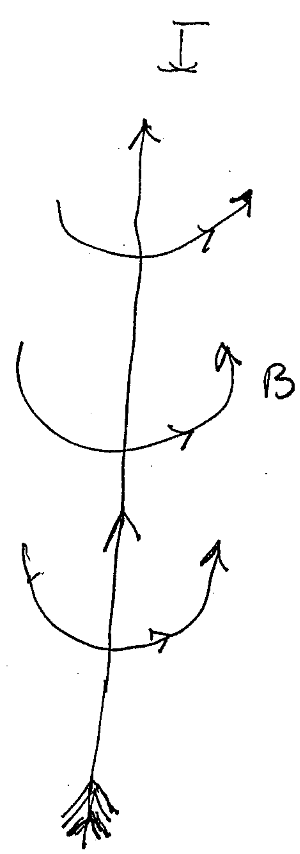
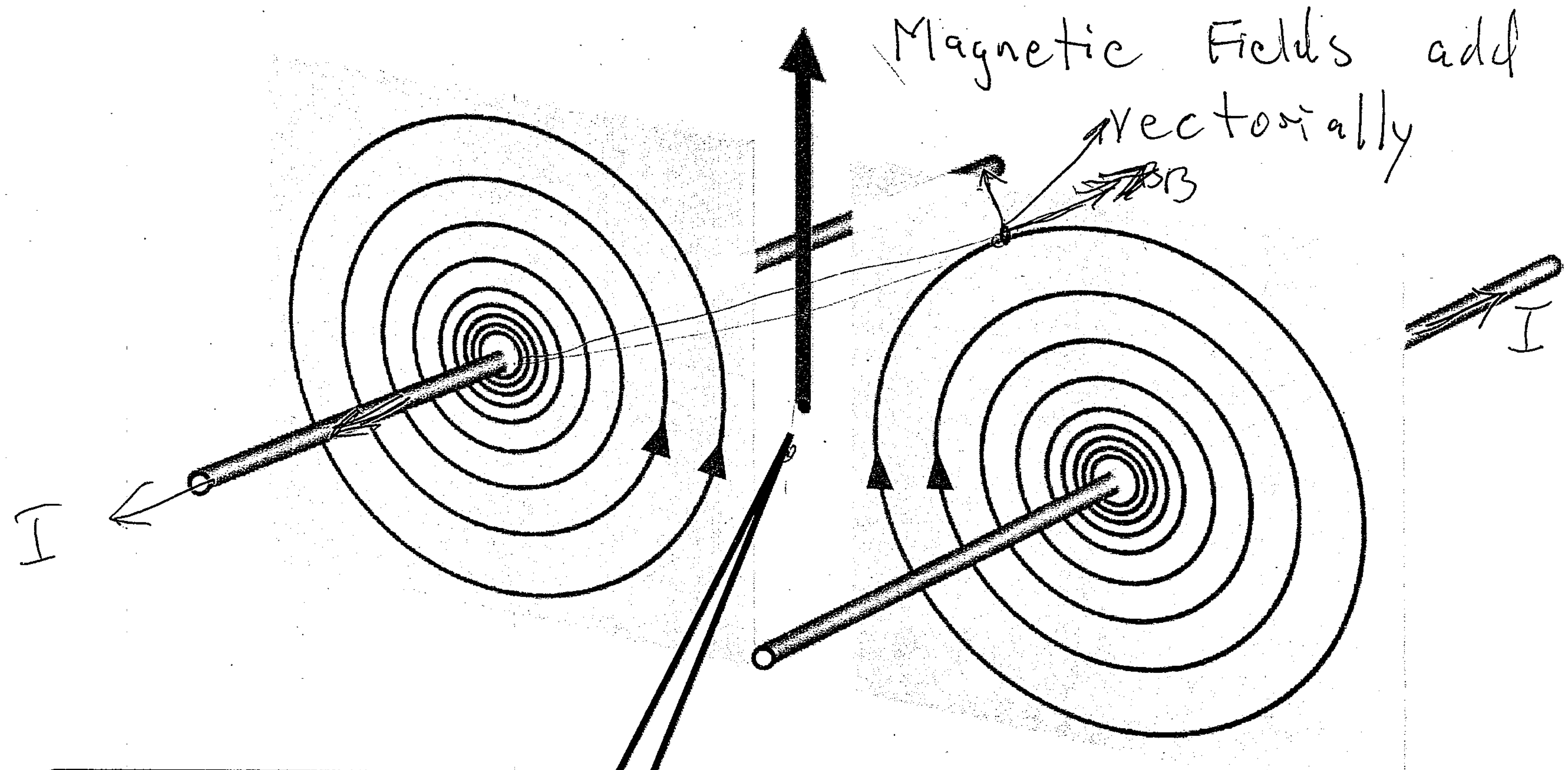


Figure 29-10 Physics for Engineers and Scientists 3/e

Magnetic Field of a straight current



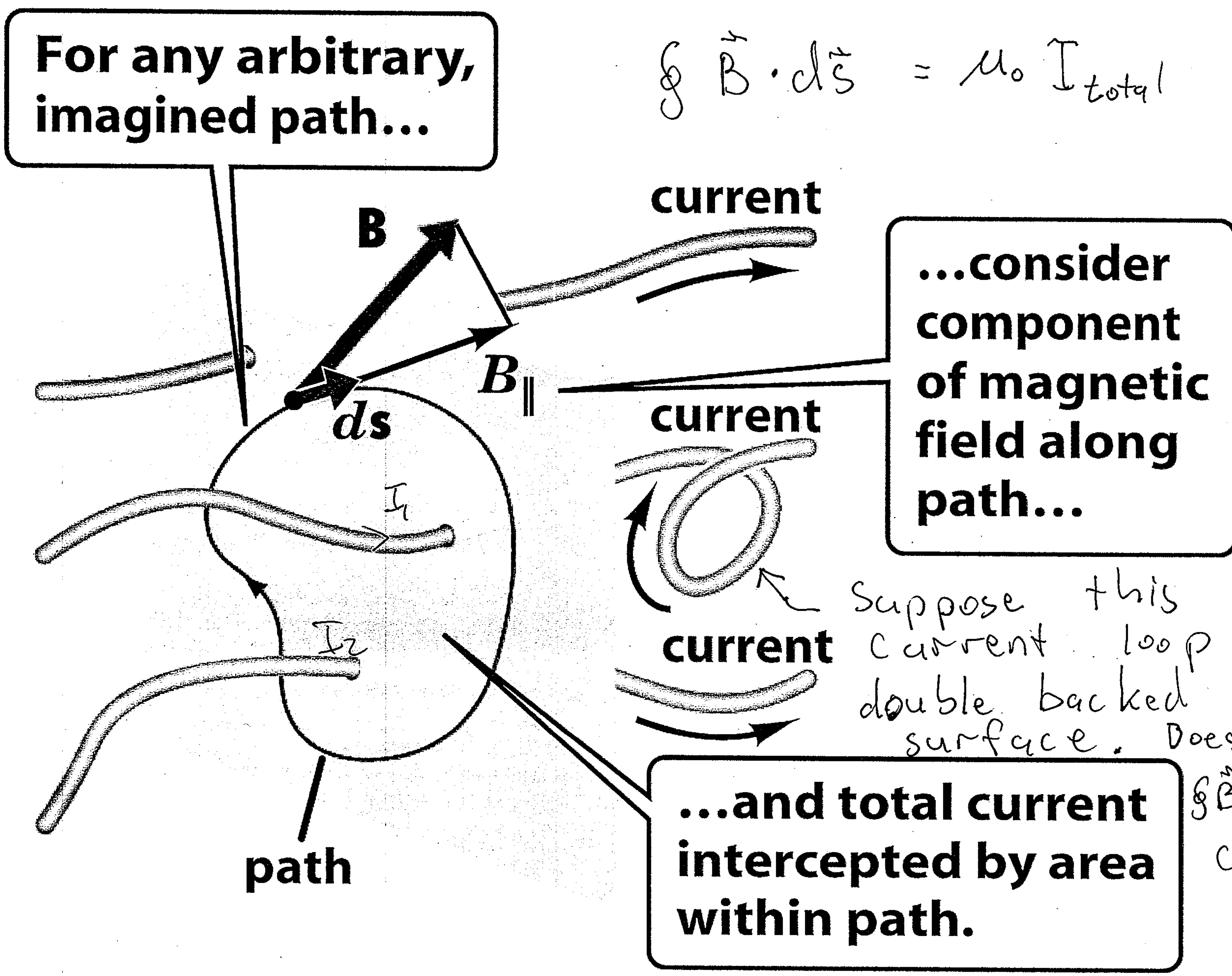


...individual magnetic fields between wires that **are parallel.**

Figure 29-19b Physics for Engineers and Scientists 3/e

Ampere's Law

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{total}$$



Suppose this current loop double backed on surface. Does $\oint \vec{B} \cdot ds$ change?

(a) yes (b) no ✓

Figure 29-21 Physics for Engineers and Scientists 3/e

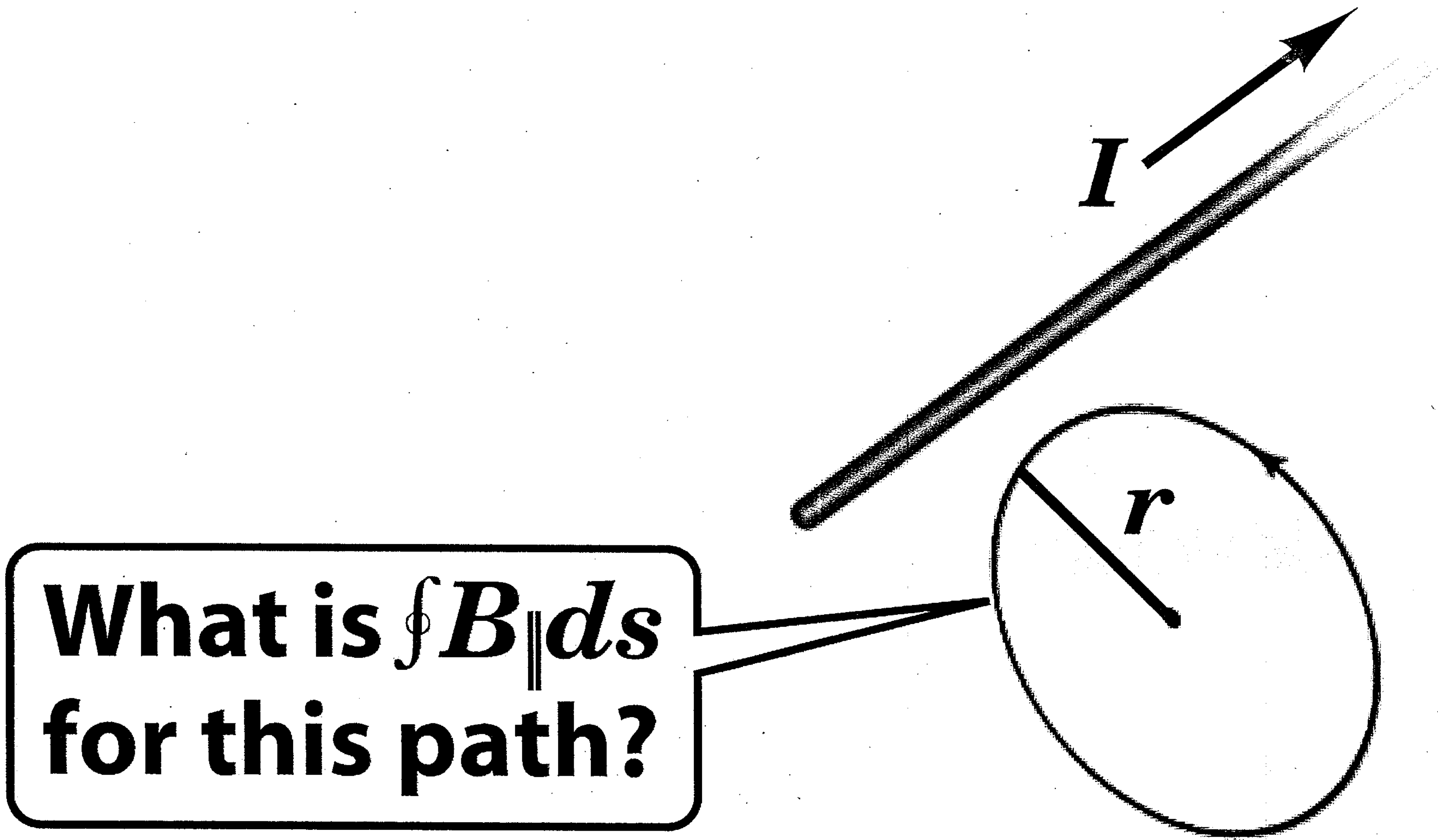


Figure 29-27 Physics for Engineers and Scientists 3/e

Calculating B- fields with Ampere's Law.

Constant current density within r_0.

What is magnetic field at radius r?

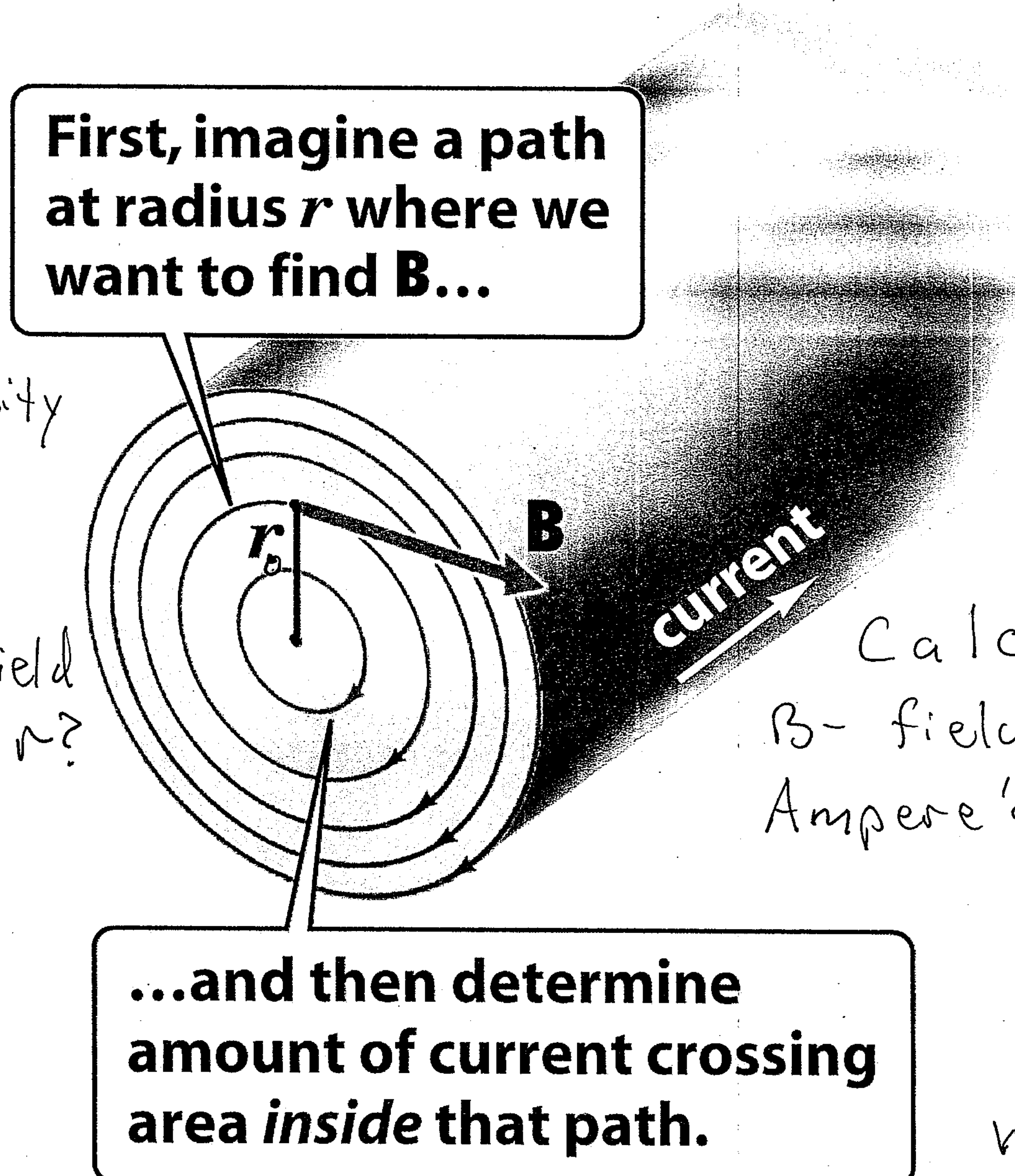
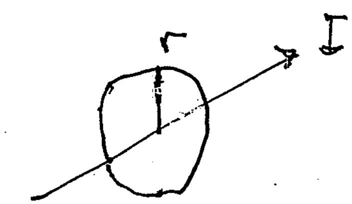


Figure 29-22 Physics for Engineers and Scientists 3/e



What is magnetic field at radius r?