

2. Suppose an electronic device with resistance  $R$  needs between 1.4 and 2.0 volts to operate. Two AA batteries with  $\epsilon = 1.5\text{V}$  and  $r = 0.25\Omega$  are connected (Fig. 2) in parallel with the device. (a) If  $R = 50\Omega$ , what is the current flow? (b) If the batteries each have a charge  $q = 2.5\text{A hr}$ , how long will the current flow?

$$1.5 - I_1(0.25) + I_2(0.25) - 1.5 = 0$$

$$\epsilon_2 - I_2 \cdot r_2 - I \cdot R = 0$$

$$1.5 - I_2 \cdot 0.25 - (I_1 + I_2) \cdot 50 = 0$$

$$1.5 - I_2 \cdot 100.25 = 0$$

$$I_2 = 0.015\text{A}$$

$$I_1 = 0.015\text{A}$$

$$I = 0.030\text{A}$$

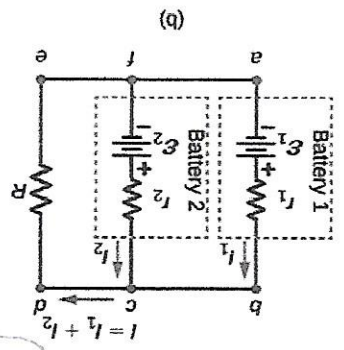
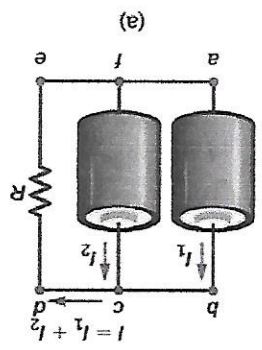


Figure 2: Two AA batteries are connected in parallel to power a calculator represented by  $R$ . (a) The batteries are connected in parallel. (b) A circuit diagram representing the circuit in (a).

## 4 Chapter 11: Magnetic Forces and Fields

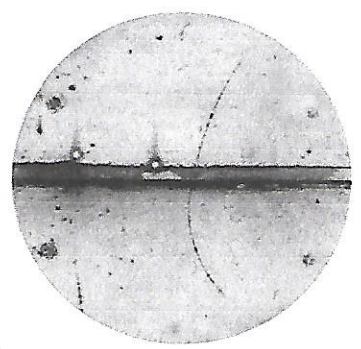


Figure 3: The trajectory of a subatomic particle through a cloud chamber.

1. The experimental result depicted in Fig. 3 shows the trajectory of a subatomic particle that is revealed by a device called a cloud chamber. The particle bends to the left after passing through a lead plate. (a) The magnetic field is into the page. What is the sign of the charge of this particle? (b) It was later deduced that this particle had the mass of an electron, from the radius of curvature. Why is that strange? (c) Imagine the B-field had a strength of  $0.05\text{ T}$  and the velocity of the particle was  $10^6\text{ m/s}$ . What was the force on the particle, and in what direction was the force?

$$B = 0.05$$

$$v = 10^6\text{ m/s}$$

$$q = 1.6 \times 10^{-19}$$

$$F = ?$$

$$F = qvB \sin \theta$$

$$F = (1.6 \times 10^{-19})(10^6)(0.05)$$

$$F = 8 \times 10^{-14}\text{ N}$$

direction of particle is towards the center

b) it says it's an electron which is negative  
 due to the particle moving a positive charge in  $\vec{A}$

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

$$\vec{v} \times \vec{B} \text{ goes left}$$

$$\vec{F} \text{ circular motion}$$

$$\text{goes to the center}$$

$$\text{mean } q \text{ is positive}$$

$$t = 83.8\text{ hr}$$

$$I = q/t \rightarrow t = \frac{q}{I}$$

$$t = 2.5\text{A hr}$$