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 $q = 2.5$ A hr, how long will the current flow?

a. $0.25I_1 - 0.25I_2 + 1.5 - 1.5 = 0$

$I_2 r_2 + (I_1 + I_2)R - 1.5 = 0$

$0.25I_2 + (I_2 + I_2)(50) - 1.5 = 0$

$I_2 = 0.015\text{A}$

$0.015(2) = 0.03\text{A}$

b. $I = \frac{Q}{T}$

$T = \frac{Q}{I}$

$2.5(2) = 5$

$\frac{5}{0.03} = T$

$= 166.7\text{ h}$

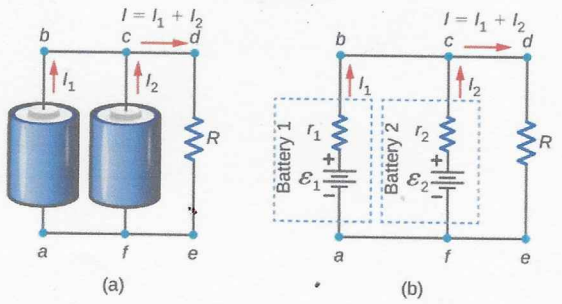

Figure 2: Two AA batteries are connected *in parallel* to power a calculator represented by R. (a) The batteries are connected in parallel. (b) A circuit diagram representing the circuit in (a).

4 Chapter 11: Magnetic Forces and Fields

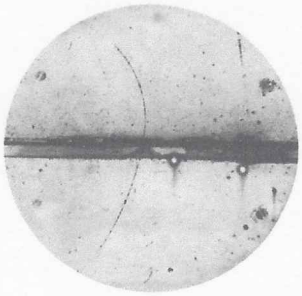

Figure 3: The trajectory of a sub-atomic particle through a cloud chamber.

1. The experimental result depicted in Fig. 3 shows the trajectory of a sub-atomic 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 elecron, from the radius of curvature. Why is that strange? (c) Imagine the B-field had a strength of 0.05 T and the velocity of the paricle was 10^6 m/s. What was the force on the particle, and in what direction was the force?

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

a. positive because upward motion and positive charge and it's a positively charged particle (right hand rule)

b. strange because it has the mass of an electron but it is positively charged whereas an electron is negatively charged

c. $F = 1.6 \times 10^{-19} \times 10^6 \times 0.05$

$= 8.0 \times 10^{-15}\text{ N}$, towards left b/c right hand rule