



电子科技大学
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Physical Experiments 7

Pre-lab Assignment

Use Hall Effect to measure Magnetic Field

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Score

Answers to Questions (20 points)

(1) In Fig. P3.2-1, there are n charge carriers per cubic meter in a strip of semiconductor with a strip shape. Each carrier with negative charge q passes through an area A with a speed v . The applied magnetic field B is perpendicular to the upper surface of the stripe.

I. What is the magnitude of the I_H ?

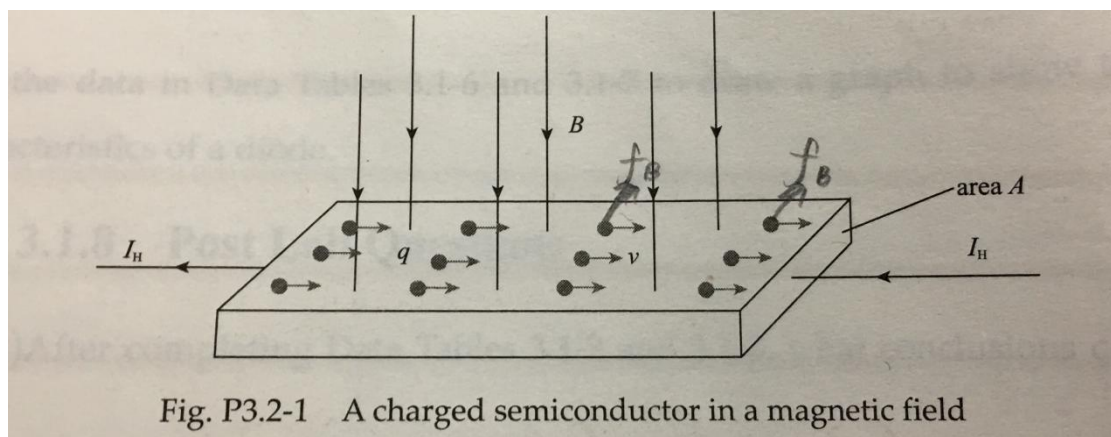
$$I_H = -nqvA$$

II. When the magnetic field is switched on, what force will be exerted on one moving charge carrier? What is the magnitude of the force? Mark the direction of the force on the diagram.

Lorentz force will be exerted on one moving charge carrier.

The magnitude of Lorentz force is $f_B = evB$, where e is the charge of a carrier, v is the velocity of the charge carrier, and B is the magnetic field applied on the current.

The direction of Lorentz force is as the diagram below



III. After some time there will be higher density of negative charge near the rear edge than near the front edge. Why?

When a magnetic field is applied on a current, the moving charge carriers will experience a Lorentz force, which will force those charge carriers move

decompositely towards the rear edge.

IV. After the accumulation of the negative charge carriers at the edge of the strip, what force will be exerted on one moving charge? How big must it be so that there is no further change in the number of negatively charged particles near the edge?

Lorentz force f_B and electrostatic force f_E will be exerted on one moving charge carriers.

$$\text{The magnitude is } f_E = f_B \Rightarrow eE_H = evB$$

(2) Was Edwin Hall awarded the Noble Prize in history? Who won the Noble Prize in physics for the contribution in connection with Hall effect? Give some details on the winner's name, the year, and the specific contribution.

Edwin Hall wasn't awarded the Noble Prize. The German physicist K. Klitzing won the Noble Prize in 1985 because he had found quantum Hall effect.