Earth's Magnetic Field; Magnetic Field of Permanent Magnet

TOPICS AND FILES

E&M Topics

Earth's magnetic field; dip angle

Magnetic field strength vs distance

Capstone Files

77 Earth Mag Field.cap

78 Permanent Magnet.cap

EQUIPMENT LIST

Qty	Items	Part Numbers
1	PASCO Interface (for two sensors)	
1	Magnetic Field Sensor	CI-6520A
1	Rotary Motion Sensor	CI-6538
1	Zero Gauss Chamber	EM-8652
1	Dip Needle	SF-8619
1	Adjustable Angle Clamp	ME-8744
1	Angle Indicator	ME-9495
1	Universal Table Clamp	ME-9376B
1	45-cm Stainless Steel Rod (non-magnetic)	ME-8736
1	Linear Motion Accessory	CI-6688
1	Magnet, disk, Neodymium, 0.125" diameter	
1	Double Rod Clamp	ME-9873
1	Pulley Mounting Rod	SA-9242
2	Large Rod Base	ME-8735
2	Rod, 45-cm	ME-8736
1	Tape, sticky	

INTRODUCTION

This lab has two parts.

The purpose of Experiment 1 is to measure the magnitude and direction of the Earth's magnetic field. Use a magnetic field sensor mounted on a rotary motion sensor. Rotate the magnetic field sensor on the rotary motion sensor to measure the directional variation in the Earth's field. Use *Capstone* to measure and display the magnetic field strength versus direction.

The purpose the Experiment 2 is to measure the magnitude field strength of a small neodymium magnet as the distance from the magnet increases. Use a magnetic field sensor and a rotary motion sensor. Use *Capstone* to measure and display the magnetic field strength versus distance.

BACKGROUND

The magnitude of the Earth's magnetic field varies over the surface of the Earth. The horizontal component of the Earth's magnetic field points north (toward the magnetic south). Thus, the north end of a compass needle is attracted to the south end of the Earth's magnetic field. Therefore, the pole that is referred to as "north" is actually a south magnetic pole.

The total magnetic field points at an angle from the horizontal. This angle (θ) is called the dip angle. An example for the northern hemisphere is shown in Figure 1.

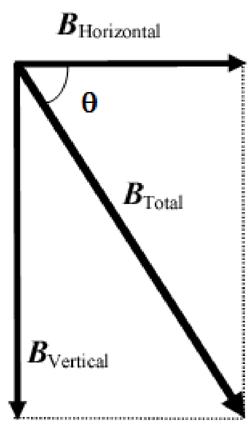

Figure 1

$$\cos\theta = \frac{B_{\text{Horizontal}}}{B_{\text{Total}}} \tag{1}$$

The strength of a magnetic field varies with distance from the magnet. While it is possible that the strength of the magnetic field is inversely proportional to the square of distance, as with the strength of a gravitational or an electrical field, the strength of the magnetic field could very well vary in a different way relative to the distance.

The gravitational field or electric field of a point mass or charge is radial, while the magnetic field of a magnet consists of complete loops that surround and go through the magnet.

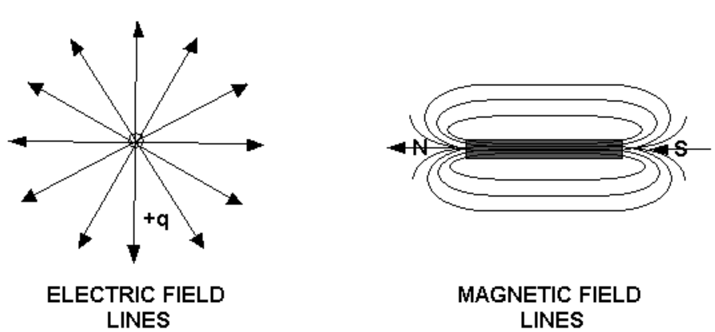

Figure 2

