MAGNETISM

19TH CENTURY (MODERN) VIEW OF MAGNETISM

(1) SOMETHING CREATES A MAGNETIC FIELD

(2) THE MAGNETIC FIELD EXERTS A FORCE ON SOMETHING ELSE

BASIC MAGNETIC FIELD INFO

SYMBOL: $\vec{B}$

UNITS: TESLA (T)

MAGNETIC FIELD IS A VECTOR AT EACH POINT IN SPACE.

WHAT CREATES A MAGNETIC FIELD?

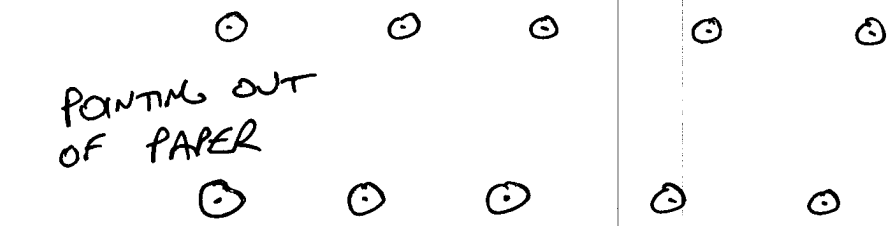
(1) A MAGNET

- THE EARTH CREATES A MAGNETIC FIELD OF ABOUT 0.5×10^{-4} T NORTH

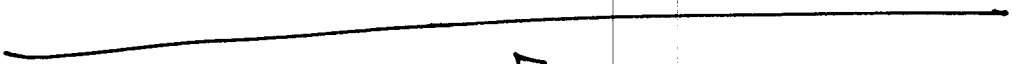
(2) A MOVING CHARGED PARTICLE

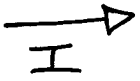
(3) A CURRENT

A LONG, STRAIGHT WIRE



POINTING OUT OF PAPER





POINTING INTO PAPER

CURRENT FLOWING IN THE WIRE

$$B = \frac{\mu_0 I}{2\pi r}$$

DISTANCE FROM WIRE

MAGNITUDE OF THE MAGNETIC FIELD PRODUCED BY THE WIRE

$$\mu_0 = 4\pi \times 10^{-7}\ T \cdot m/A$$

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$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7}\ T\cdot m/A)(65\ A)}{2\pi (0.060\ m)}$$

$$= 2.17 \times 10^{-4}\ T$$

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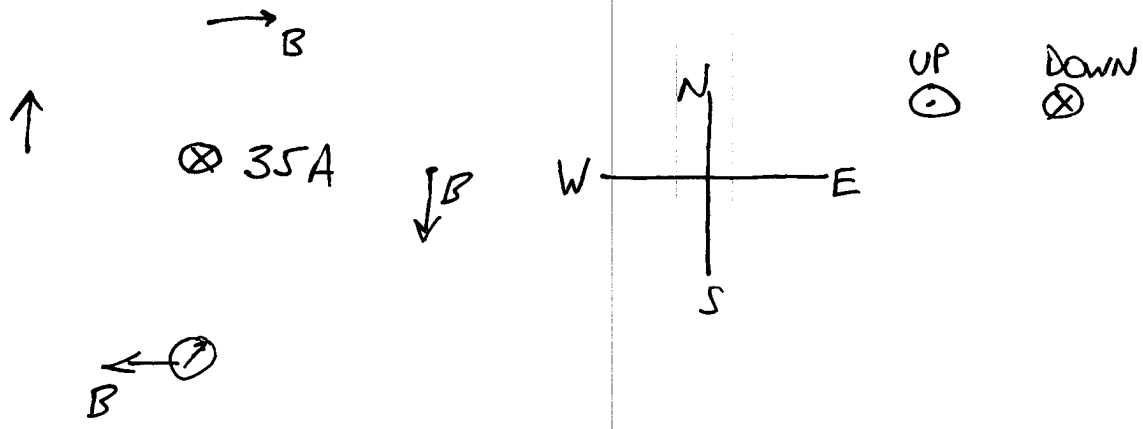


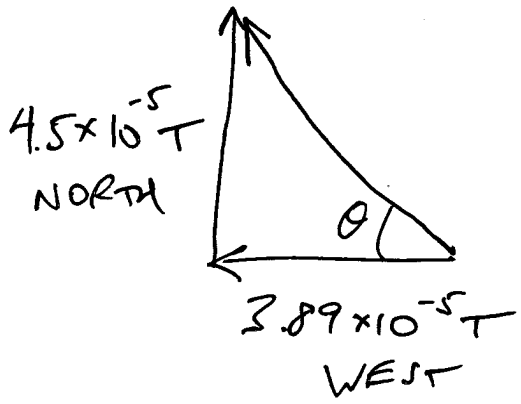
CONTRIBUTION FROM THE WIRE:

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7}\ T\cdot m/A)(35A)}{2\pi (0.18m)}$$

$$= 3.89 \times 10^{-5}\ T \quad \text{WEST}$$

CONTRIBUTION FROM EARTH:

$0.45 \times 10^{-4}\ T$ NORTH



$$\theta = \tan^{-1}\left(\frac{4.5}{3.89}\right) = 49^\circ$$

49° NORTH OF WEST

OR

41° WEST OF NORTH