SUBJECT : SCIENCE (PHY)

CHAPTER-13:

MAGNETIC EFFECT OF ELECTRIC CURRENT

TOPIC-2:

MAGNETIC FIELD DUE TO A CURRENT CARRYING STRAIGHT CONDUCTOR:

OBJECTIVES:

Upon completion of the topic, you will be able to

1. EXPLAIN WHAT HAPPEN WHEN CURRENT IS PASSED THROUGH A STRAIGHT CONDUCTOR.
2. DRAW THE MAGNETIC LINES OF FORCE AROUND A STRAIGHT CURRENT CARRYING CONDUCTOR.
3. EXPLAIN FACTORS ON WHICH THE MAGNITUDE OF FIELD DEPEND
4. EXPLAIN MAXWELL'S RIGHT HAND THUMB RULE

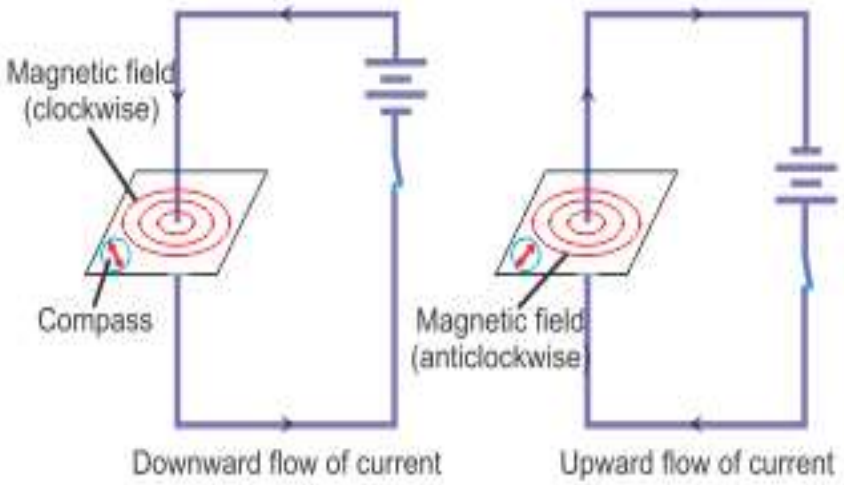
Magnetic Field due to Current in a Straight Conductor

The magnetic Field created by electric current flowing through a straight conductor acts along concentric circles around it, with their plane perpendicular to the straight wire and with their centres lying on the wire.

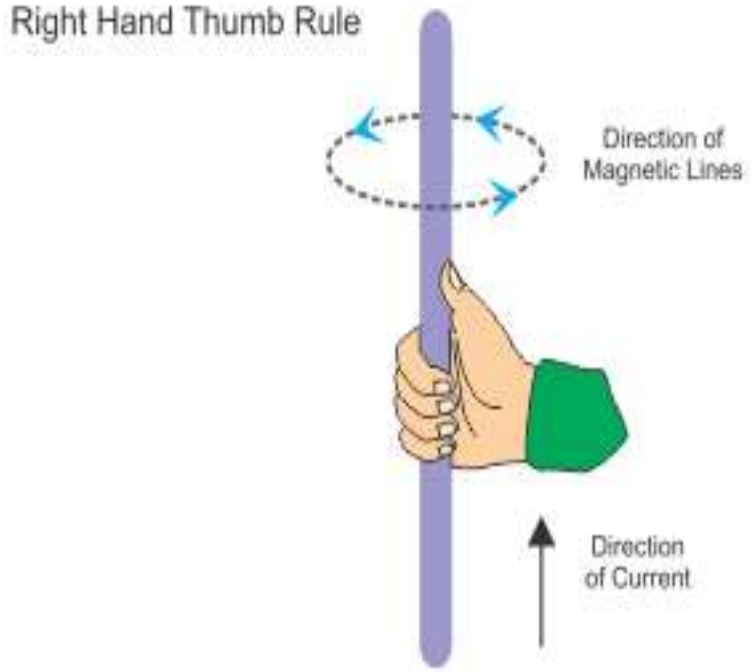
- When the direction of current in the wire is reversed, the direction of magnetic field gets reversed.
- On increasing the current in the wire, the magnetic field strength gets increased.

The direction of the magnetic field in a straight conductor is given by the Right Hand grip rule or Right hand thumb rule.

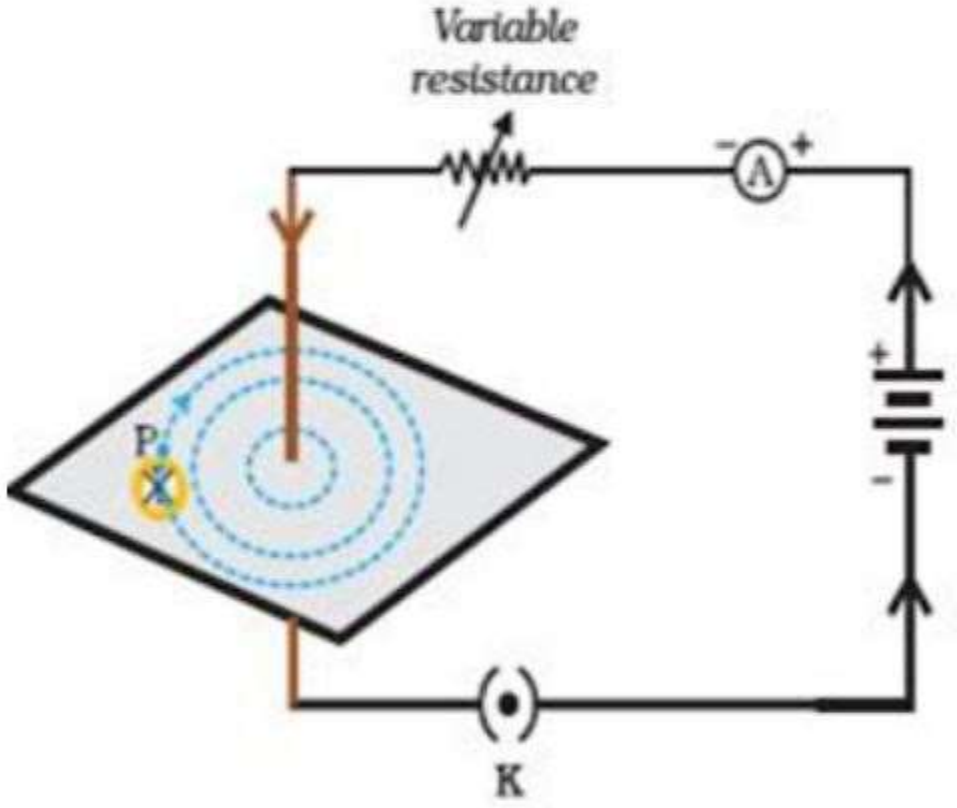
According to this rule, if you hold the current carrying wire in your right hand with the thumb pointing along the direction of the current, then the direction in which fingers curl gives the direction of the field.

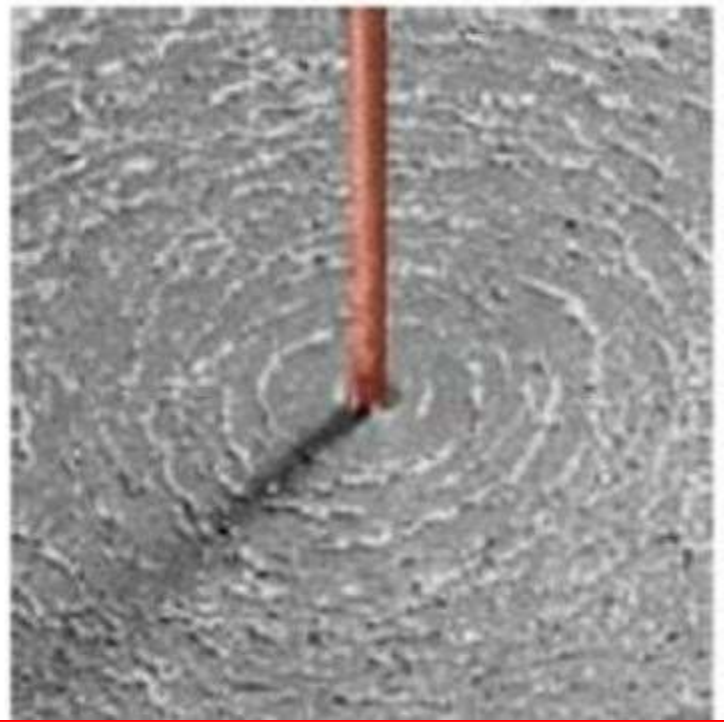


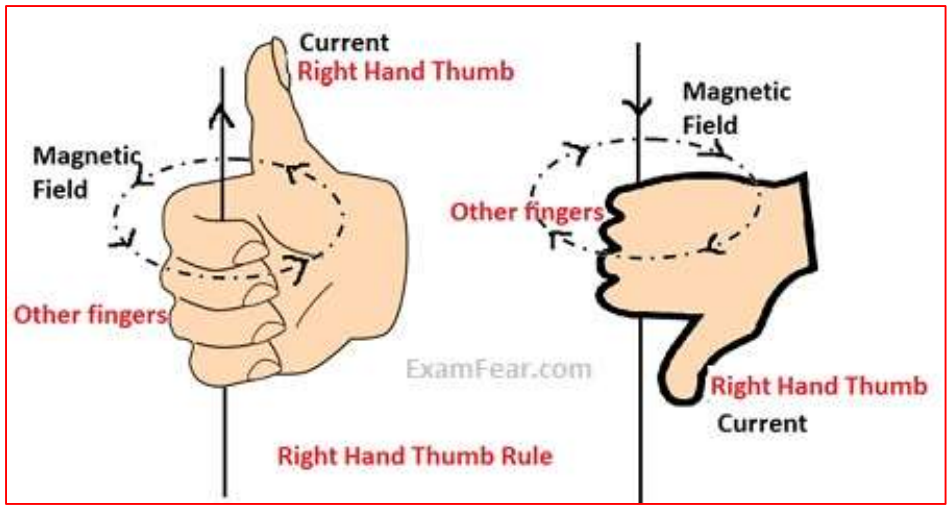
Lines of force due to a current carrying straight conductor



MAGNETIC FIELD DUE TO CURRENT CARRYING STRAIGHT CONDUCTOR







When electric current is passed through a straight conductor, a magnetic field is produced around it. The pattern of magnetic lines of force around the conductor is shown by dotted lines in Fig-1. It is concentric circular in shape.

Direction of Field:

Direction of field is obtained using Maxwell's Right Hand Thumb Rule. The thumb indicates direction of current and curl of other fingers indicate direction of magnetic field.

Factors on which the strength or magnitude of field depend(B):

(a) Electric current(I):

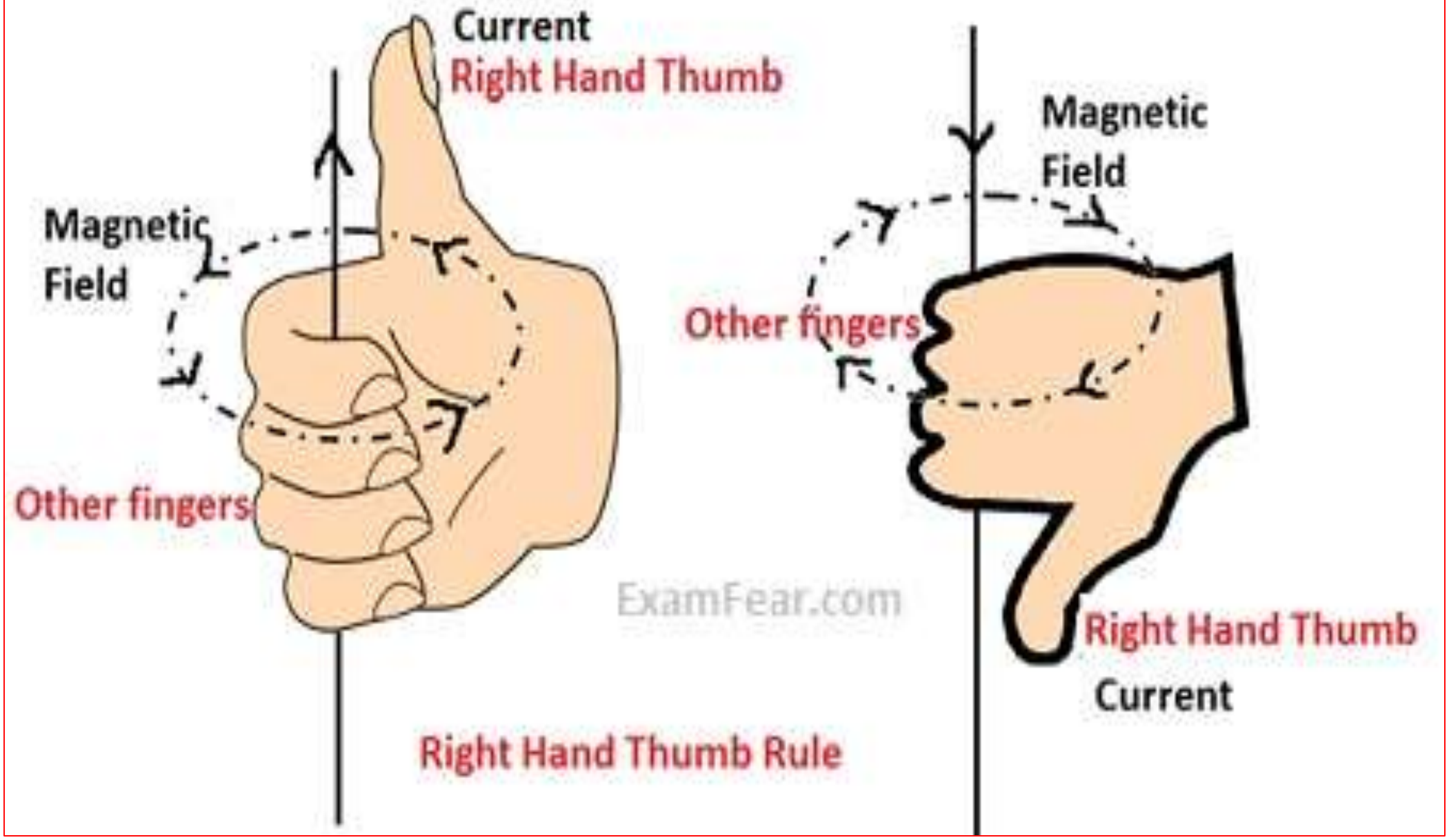
$$B \propto I$$

(a) Distance from the wire(d):

$$B \propto 1/d$$

Note: change of strength with factors can be known by placing a compass in the field.

RIGHT HAND THUMB RULE:



RIGHT HAND THUMB RULE: If a current carrying conductor is imagined to be held in the right hand such that the thumb points in the direction of the current, then the curled fingers of the hand indicate the direction of magnetic field (as shown in the figures)

Unit of magnetic field strength(B):

1. Tesla (SI unit)
2. Gauge (CGS unit)

1. Two parallel conductors carrying current in the same direction attract each other.
2. Two parallel conductors carrying current in the opposite direction repel each other

HOME-WORK:

Q1:Draw a diagram to show the pattern of magnetic lines of force around a straight current carrying conductor.

Q2: Name the factors on which strength of magnetic field due to current carrying straight conductor depend.

Q3: State Right Hand Thumb Rule

Q4: A horizontal power line carries current in east to west direction. What is the direction of magnetic field due to the current in the power line at a point above and at a point below the power line?

Q5: What happens when current is passed in the same direction through two parallel straight conductors?

Q6: What happens when current is passed in the opposite direction through two parallel straight conductors?

Q7: Name the units used to measure the strength of magnetic field.