LENZ'S LAW DEMONSTRATOR

A CHANGING MAGNETIC FIELD INDUCES AN ELECTRIC FIELD - FARADAY'S LAW OF INDUCTION
A CIRCULATING CURRENT INDUCES AN ELECTRIC FIELD - AMPERE'S LAW
IF A MAGNETIC FIELD CHANGES WITHIN A CONDUCTOR, A CURRENT CAN BE PRODUCED WHICH PRODUCES A SECONDARY MAGNETIC FIELD. LENZ'S LAW STATES THAT THIS SECONDARY MAGNETIC FIELD ALWAYS OPPOSES THE CHANGE IN THE ORIGINAL FIELD.
THIS APPARATUS PROVIDES A DRAMATIC DEMONSTRATION OF LENZ'S LAW.

YOUR KIT COMPRISES :

1 x ALUMINIUM TUBE 1.5m.
1 x MOUNTING ARM WITH VELCRO ATTACHING PAD
1 x FALLING MASS.
1 x FALLING MASS WITH ENCASED NEODYMIUM MAGNET.

OTHER APPARATUS REQUIRED BUT NOT SUPPLIED :

1 x SPRING BALANCE

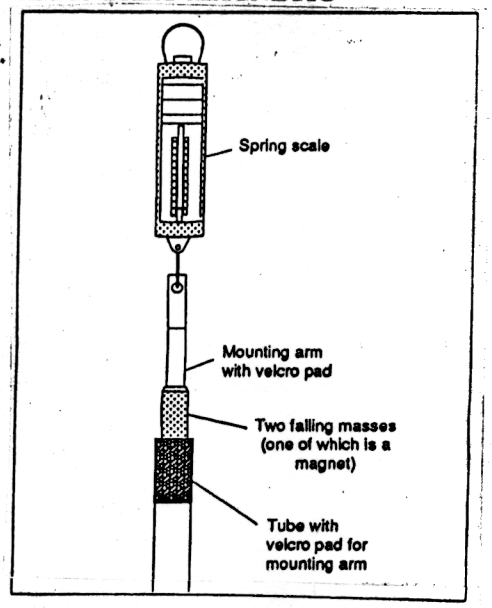


Figure 1 Equipment and Setup

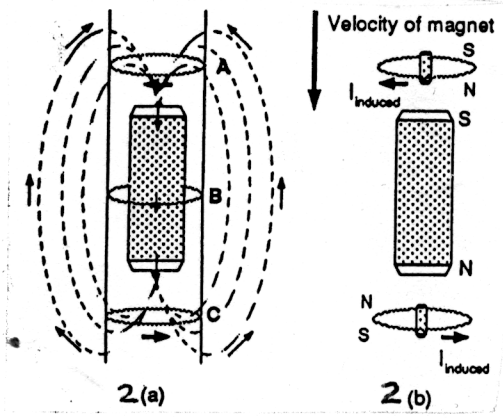
INSTRUCTIONS :

HINT : INITIALLY DO NOT INFORM YOUR STUDENTS
THAT ONE MASS CONTAINS A MAGNET!

1. SET UP THE EQUIPMENT AS SHOWN IN FIGURE 1.
2. HOLD THE UNMAGNETISED MASS OVER THE OPENING IN THE TUBE AND THEN DROP IT.
3. REPEAT THE SAME ACTION WITH THE MAGNETISED MASS.

OUTCOME :

THE MAGNETISED MASS TAKES APPROXIMATELY TEN TIMES LONGER TO FALL THROUGH THE TUBE.
ASK YOUR STUDENTS WHY THIS IS SO?
ATTACH THE SPRING BALANCE, WHAT HAPPENS TO THE WEIGHT OF THE TUBE WHEN THE WEIGHT OR THE MAGNET ARE FALLING?
THE FALLING MASS DOES NOT EFFECT THE WEIGHT WHILE THE MAGNETIC FALLING MASS INCREASES THE MASS AS IT FALLS THROUGH THE TUBE.



THEORY :

FIGURE 2a SHOWS A DIAGRAM OF THE MAGNET FALLING THROUGH THE TUBE WITH THE NORTH POLE FACING DOWN. THREE CROSS SECTIONS OF THE TUBE A, B, & C ARE SHOWN. THE MAGNETIC FIELD THROUGH ALL CROSS SECTIONS POINTS DOWN.
IN SECTION A: THE MAGNETIC FIELD DECREASES AS THE MAGNET FALLS. LENZ'S LAW STATES THAT THE INDUCED FIELD WILL THEREFORE POINT DOWN, REDUCING THE RATE AT WHICH THE TOTAL FIELD DECREASES.
IN SECTION B: THE FIELD FROM THE FALLING MAGNET IS RELATIVELY CONSTANT, THEREFORE THERE IS NO INDUCED FIELD IN THIS SECTION.
IN SECTION C: THE FIELD FROM THE FALLING MAGNET INCREASES AS THE MAGNET FALLS AND ACCORDING TO LENZ'S LAW, THE INDUCED FIELD WILL POINT UP, REDUCING THE RATE AT WHICH THE TOTAL FIELD INCREASES.

AN EASY WAY TO VISUALISE THE EFFECT OF THESE FIELDS ON THE FALLING MAGNET IS TO IMAGINE THE FIELDS AS IF THEY WERE PRODUCED BY TINY MAGNETS, AS SHOWN IN ILLUSTRATION 2b. THE DIRECTION OF THE FIELD OF THE UPPER MAGNET IS THE SAME AS THE FALLING MAGNET, NORTH AND SOUTH POLES ARE ADJACENT AND THE FALLING MAGNET IS ATTRACTED, SLOWING IT'S MOTION. THE FIELD OF THE LOWER MAGNET REPELS THE FALLING MAGNET, AGAIN SLOWING IT'S MOTION.

HAPPY EXPERIMENTING.