

## Student sheet: Electromagnetism – Transmission of Electricity.

### Objectives:

By the end of the session you will understand why electricity is distributed at high voltage, how transformers enable this, and what frequency electricity is distributed.

### Resources required:

A large U shaped magnet, a metal wire, two 60° glass prisms, two G clamps, a set of slotted masses, a ruler, a variable low voltage A.C power supply (0 – 12V, 5A), an A.C ammeter, leads, two crocodile clips, access to an accurate balance measuring to at least 0.01 gm. Access to internet for [www.twothirtyvolts.org](http://www.twothirtyvolts.org)

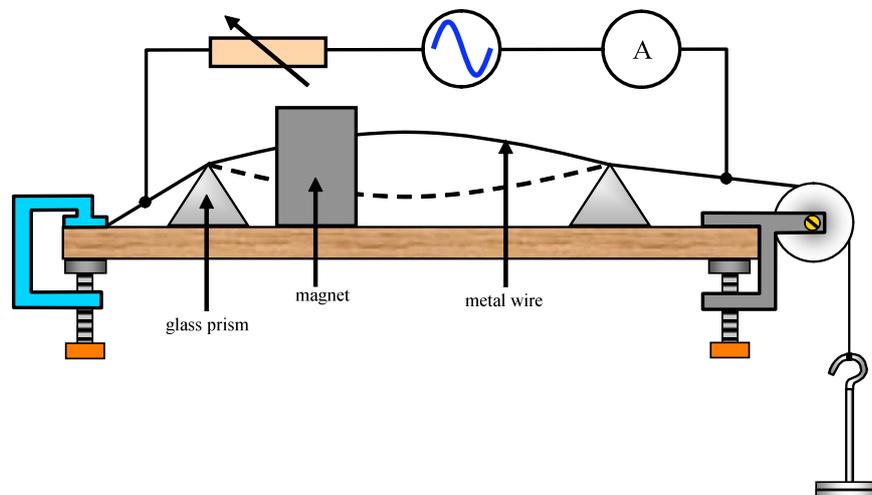
### Introduction:

Access and review the Transmission of Electricity Student Revision Notes at [www.twothirtyvolts.org](http://www.twothirtyvolts.org).

### Activity:

Working in groups of four undertake the following tasks:

Set up the apparatus as shown and connect the low voltage ac supply to the two ends of the wire. (The current should not exceed about 4A).



Vary the tension and the length until the wire vibrates strongly, i.e. a resonance condition has been found. Record the length (L) and the tension (T) for series of pairs of values. Measure the mass per unit length (m) of the wire.

### Theory:

When the power supply is switched on the wire will experience a force due to the combination of the magnetic fields of the magnet and the field produced by the current on the wire. Since the current in the wire is a.c the force will be constantly changing direction and so the wire will oscillate in the magnetic field of the magnet. The equation for the frequency (f) of a stretched wire length L and under a tension T is:

$$\text{Frequency } (f) = 1/(2L) \times \sqrt{(T/m)}$$

## Analysis and Conclusions:

Plot a graph of  $T$  against  $L^2$  and hence calculate the frequency of the mains. The gradient of your graph ( $T/L^2$ ) will be  $4mf^2$ .

## **Further work:**

Complete Transmission of Electricity Student Quiz at [www.twothirtyvolts.org](http://www.twothirtyvolts.org) .

## **Linked Resources**

[www.twothirtyvolts.org](http://www.twothirtyvolts.org):

Transmission of Electricity 14 -16 Student Revision Notes

Transmission of Electricity 14 -16 Revision Quiz

## Worksheet: Electromagnetism – Transmission of Electricity.

Experiment Frequency of Mains Electricity Notes:

Other Observations: