TwoThirtyVolts ...and all things electrical

Lesson Plan: Electromagnetism (age 14 – 16) – Transmission of Electricity.

Objectives:

The aim of the lesson and experiment is to help the student to understand why electricity is distributed at high voltage, how transformers enable this, and what frequency electricity is distributed.

Lesson introduction (15 min):

Recap on any previous learning on generators and transformers. Introduce subject area and refer students to the Transmission of Electricity Student Revision Notes in the 'Education' section of www.twothirtyvolts.org . Allow time for students to review these. Explain experiment and learning objectives.

Lesson activity (25 min):

Group students in pairs and task them to:

- Perform the experiments detailed in the Student Sheet to measure frequency of mains electricity.

Lesson demonstration (10 min):

Select some of the students to inform the rest of the class about their findings.

Lesson review (10 min):

Recap on learning, and observations from the experiment, and get students to complete the Generators Student Quiz at www.twothirtyvolts.org to establish levels of understanding.

Resources required:

For each student group of four: A large U shaped magnet, a metal wire, two 60^{o} 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

Expected Outcomes:

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

Student sheet: Electromagnetism – Transmission of Electricity.

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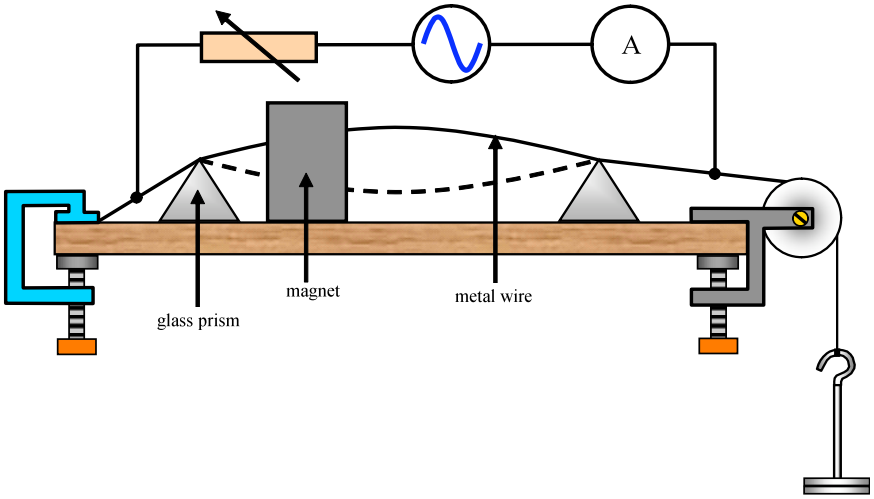
Introduction:

Access and review the Transmission of Electricity Student Revision Notes at 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:

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 .

Linked Resources

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: