

Investigation of the output of an iron-cored transformer

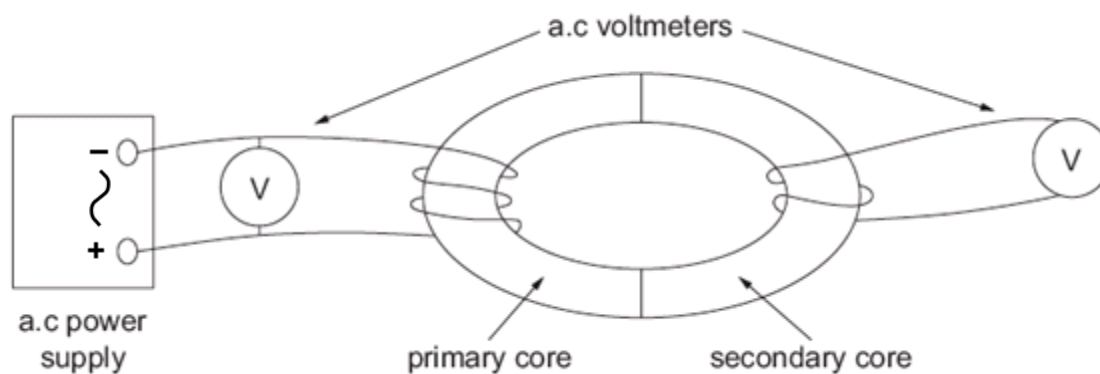
Introduction

A transformer can be constructed from iron 'C' cores and flexible insulated wire. You will investigate the relationship between the number of turns on the secondary coil and secondary voltage.

Apparatus

C-cores (20/40/60/80/100 turns)
 a.c. power supply
 2 × a.c. voltmeters $\pm 0.01V$
 connecting wires
 crocodile clips

Diagram of Apparatus



Method

1. Ensure the power supply is switched off.
2. Set up the circuit as shown with 100 turns on the primary core and 20 turns on the secondary core.
3. Switch on the power supply.
4. Record the voltages.
5. Turn off the power supply.
6. Add 20 further turns to the secondary core.
7. Repeat steps 3 to 6 to until there are 100 turns on the secondary core.

Analysis

1. Draw a graph of the number of turns on the secondary core (N_2) against the secondary voltage (V_2).

Risk Assessment

Hazard	Risk	Control measure
Hot wires can burn	Burning skin on hot wire	Do not exceed 4 V Switch off the power supply after taking readings Allow wire to cool before handling

Teacher / Technician notes

Ensure power supplies are set to a maximum of 4 V a.c. (Note a.c. must be used).

Wire used should be thin flexible insulated wire and should be cut in lengths that easily allow 100 turns to be wound around the iron core

Approximately 2 cm of the insulation should be removed from the end of each wire to allow students to connect crocodile clips to the wire.

To prevent the wires overheating the power supply should be switched off immediately after taking readings.

Please note, a.c. voltmeters should be used, or, alternatively, a multimeter set on a suitable a.c. scale.

The primary core (100 turns) should be made up in advance. Sellotape / elastic bands can be wrapped around the finished core to prevent the wire coming loose. The core should be clearly labelled (100 turns).

Students should tabulate:

Number of turns on secondary core (N_2) and the secondary voltage (V_2).

Students should design their own table, but a suggested table format is shown below.

Number of turns on primary (N_1)	Number of turns on secondary (N_2)	Primary Voltage (V_1) / V	Secondary Voltage (V_2) / V
100	20		
100	40		
100	60		
100	80		
100	100		

A graph of the number of turns on the secondary core (N_2) against the secondary voltage (V_2) should be plotted. Students should explain the relationship between the two variables. A linear relationship would be expected, with a straight line through the origin.

Students who discover a non-linear relationship should be encouraged to explain why e.g. incorrect number of turns wound on secondary coil, heat loss in wires, resistance of contact (crocodile clips).

More able students should be able to explain whether or not the variables are directly proportional to each other using data from their graphs.

More able students could use the transformer equation and their value of the primary voltage (V_1) to calculate a value for the expected secondary voltage (V_2). They could then discuss the efficiency of the transformer.

Working scientifically skills covered

1. **Development of scientific thinking**

Explain every day and technological applications of science; evaluate associated personal, social, economic and environmental implications and make decisions based on the evaluation of evidence and arguments.

3. **Analysis and Evaluation**

Present observations and other data using appropriate methods.

Carry out and representing mathematical analysis.

Interpret observations and other data including identifying patterns and trends, making inferences and drawing conclusions.

Evaluate data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.

4. **Scientific vocabulary, quantities, units, symbols and nomenclature**

Use scientific vocabulary, terminology and definitions.

Use an appropriate number of significant figures in calculations.