

Rms values, transformers and power lines

Physics grades 11-12 (A Level · IB · Class 11-12) · Lab

Name: _____ Date: _____ Class: _____

How is the output of a transformer related to the turns on its coils? You will use a demountable transformer, a low-voltage ac supply and a voltmeter to test the turns-ratio equation and see how far a real transformer falls short of the ideal.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.7.5

Aim

To investigate how the secondary voltage of a transformer depends on the number of secondary turns, and to compare the results with the ideal turns-ratio equation.

Equipment

- demountable transformer kit with a laminated iron core, one 240-turn coil and a coil tapped at 60, 120, 240 and 480 turns
- low-voltage ac power pack set to 6.0 V
- digital ac voltmeter
- connecting leads
- paper and a ruler for the graph

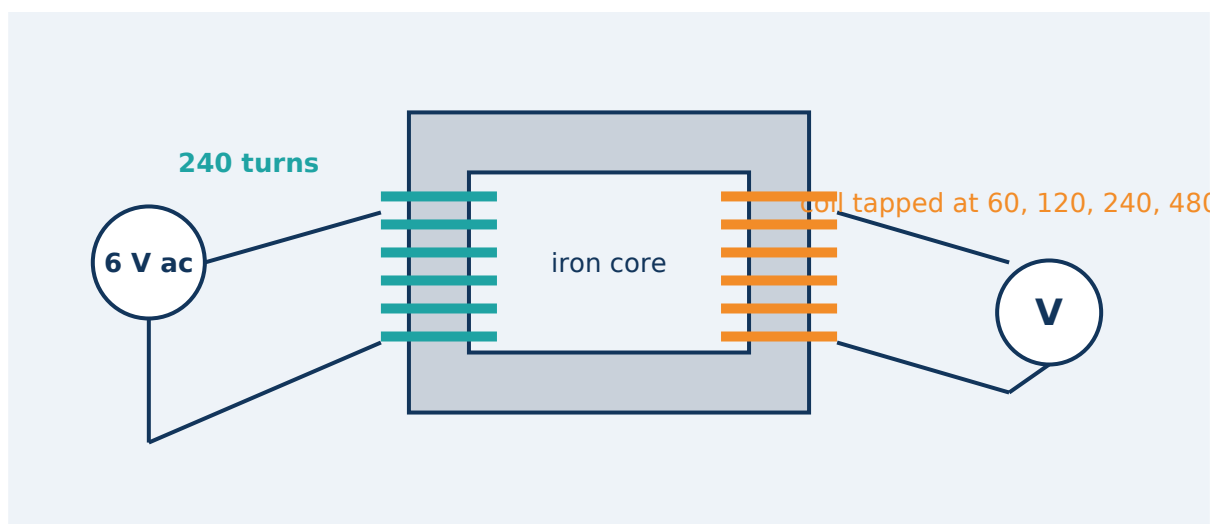
Safety

Safety

Use only the low-voltage ac pack, never the mains socket. Switch off before changing connections and check that the clamp holding the core is tight. Coils can become warm after long use, so do not leave the supply on between readings.

Method

1. Put the 240-turn coil on one limb of the core as the primary and connect it to the 6.0 V ac supply.
2. Place the tapped coil on the other limb and clamp the core pieces tightly together.
3. Connect the voltmeter across the 60-turn tapping and record the secondary voltage V_s .
4. Repeat with the 120, 240 and 480-turn tappings, switching off between readings.
5. Measure the primary voltage again at the end to check that it has not drifted.



The secondary voltage is read from the voltmeter for each tapping.

Results

Primary: $N_p = 240$ turns, $V_p = 6.0$ V ac. Readings from the secondary:

Secondary turns N_s	Measured V_s / V	Ideal $V_s = V_p N_s/N_p$ / V
60	1.4	1.5
120	2.8	3.0
240	5.6	6.0
480	11.1	12.0

Analysis questions

Question 1 Plotting

Draw a graph of secondary voltage on the y-axis against secondary turns on the x-axis, with a best-fit straight line.

Question 2 Gradient

Find the gradient and state its unit.

Question 3 Ideal gradient

Calculate the gradient predicted by $V_s/V_p = N_s/N_p$ and compare it with your value.

Question 4 Energy losses

Give two reasons why the measured voltages are lower than the ideal values.

Question 5 Why ac?

Explain why the experiment fails if a 6.0 V dc supply is used.

Question 6 Uncertainty

The voltmeter reads to 0.1 V. Calculate the percentage uncertainty for the 60-turn reading and suggest how to reduce it.