Physics Report on Flux Linkage

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1 Introduction

Aim: To determine the role of flux linkage on transformers.

We must first derive the relationship we are using to determine the effect on transformers.

After Michael Faraday discovered electromagnetic induction in 1831, changes in a magnetic field (flux) could be used to induce current between wires through electromotive forces (emfs). This is the principle behind transformers—magnetic fields around a primary coil would induce a current within a secondary coil, resulting in a transfer of voltage.

This system is governed by the following equations, one of which we will use to determine the role of flux linkage:

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} \tag{1}$$

$$\begin{aligned} &\text{Let } k = \frac{N_p}{N_s} \\ &V_p = kV_s \end{aligned} \tag{2}$$

$$k = \frac{V_p}{V_s} \tag{3}$$

2 Equipment

- 3x 500 turn coils
- 2x Multimeters
- Indeterminate quantity of Electrical wires and Alligator clips
- 6x Iron Rods

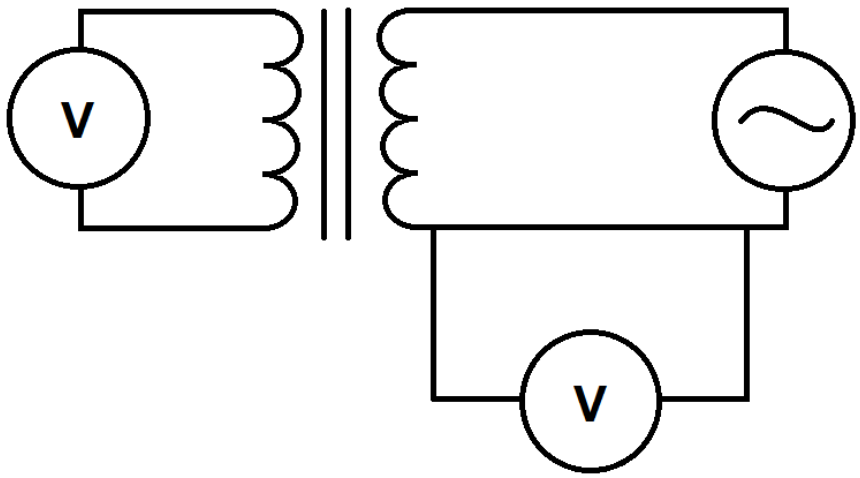

Figure 2: Circuit diagram of apparatus

3 Method

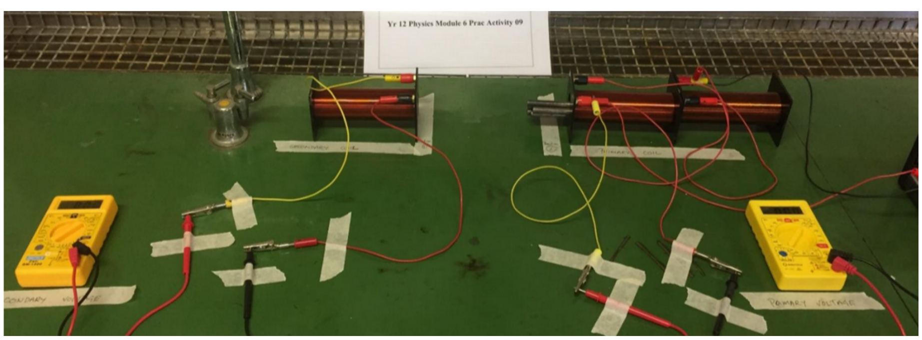

Figure 1: Model transformer connected to multimeters

1. Set up as shown in Fig 1. and Fig 2.:
a) the secondary coil far away from the primary coil, with no iron rod in either coil
b) the secondary coil adjacent to the primary coil, with no iron rod
c) the secondary coil adjacent to the primary coil, with 1 iron rods threading the primary coil to the secondary coil
d) the secondary coil adjacent to the primary coil, with 6 iron rods threading the two.
2. Plug the primary coil into an AC transformer, and the secondary coil to the

multimeter
3. Turn on the transformer, taking note of the voltage of the secondary coil.
4. Repeat this for a range of voltage values from the transformer and take note.

4 Results

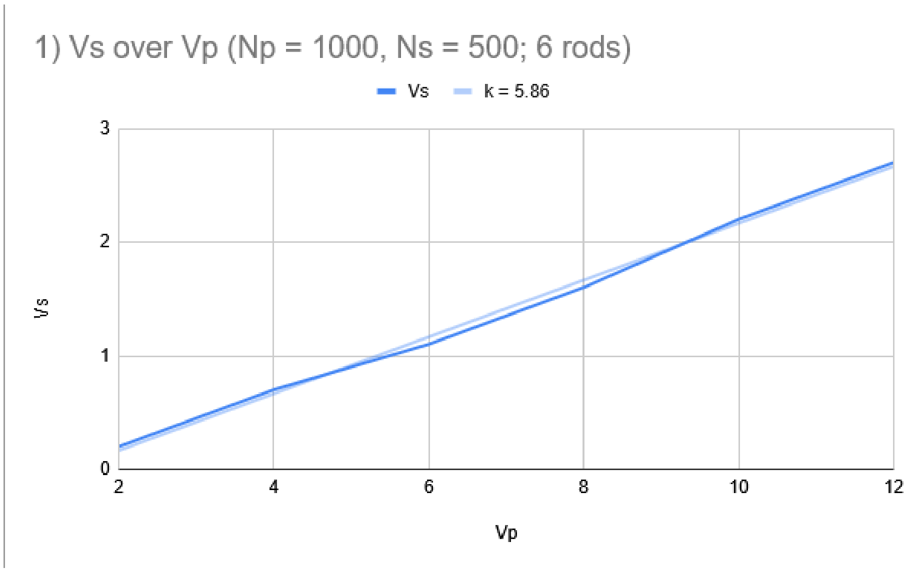

Figure 3: Graph of V_s over V_p for Trial 1)

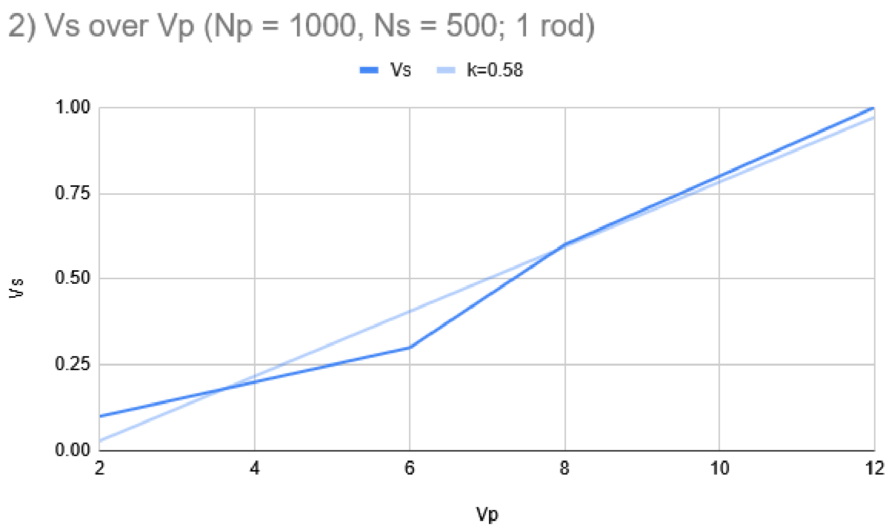

Figure 4: Graph of V_s over V_p for Trial 2)

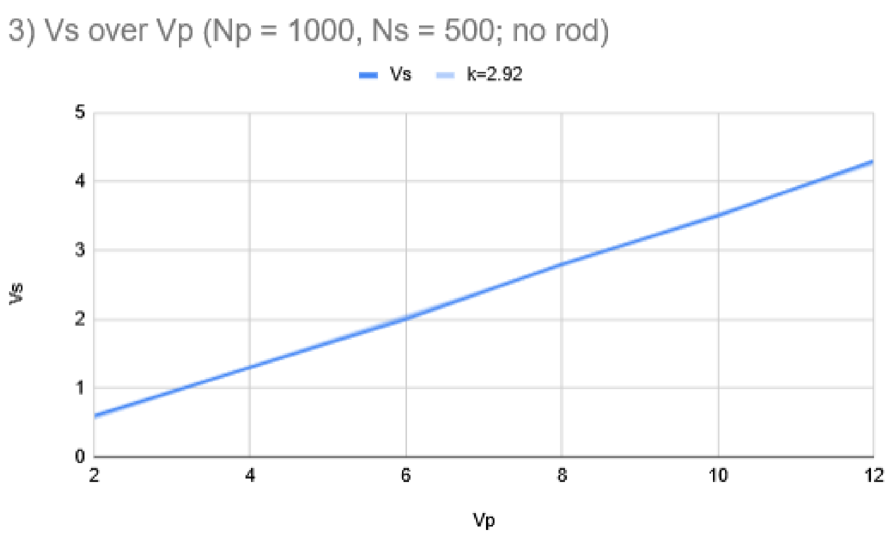

Figure 5: Graph of V_s over V_p for Trial 3)

k = (N_p/N_s)	k_1	k_2	k_3
2	5.86	15.57	-
1	-	-	2.92

Figure 6: Table comparing ideal k turn ratio to experimental k values (4)

5 Discussion

Flux linkage plays a clear role in determining the efficiency of a transformer as shown above, where k values derived from equation (4) deviate from the experimental k values.

Interestingly, the Δk between the ideal and experimental k values smaller as more iron rods are added, indicating greater efficiency.

$$\begin{aligned} \Delta k_1 = 3.86 \\ \Delta k_2 = 13.57 \end{aligned} \tag{5}$$

6 Conclusion

Through this experiment we were able to successfully identify the role of flux linkage in transformers to redirect magnetic flux and to consequently increase the efficiency of transformers.