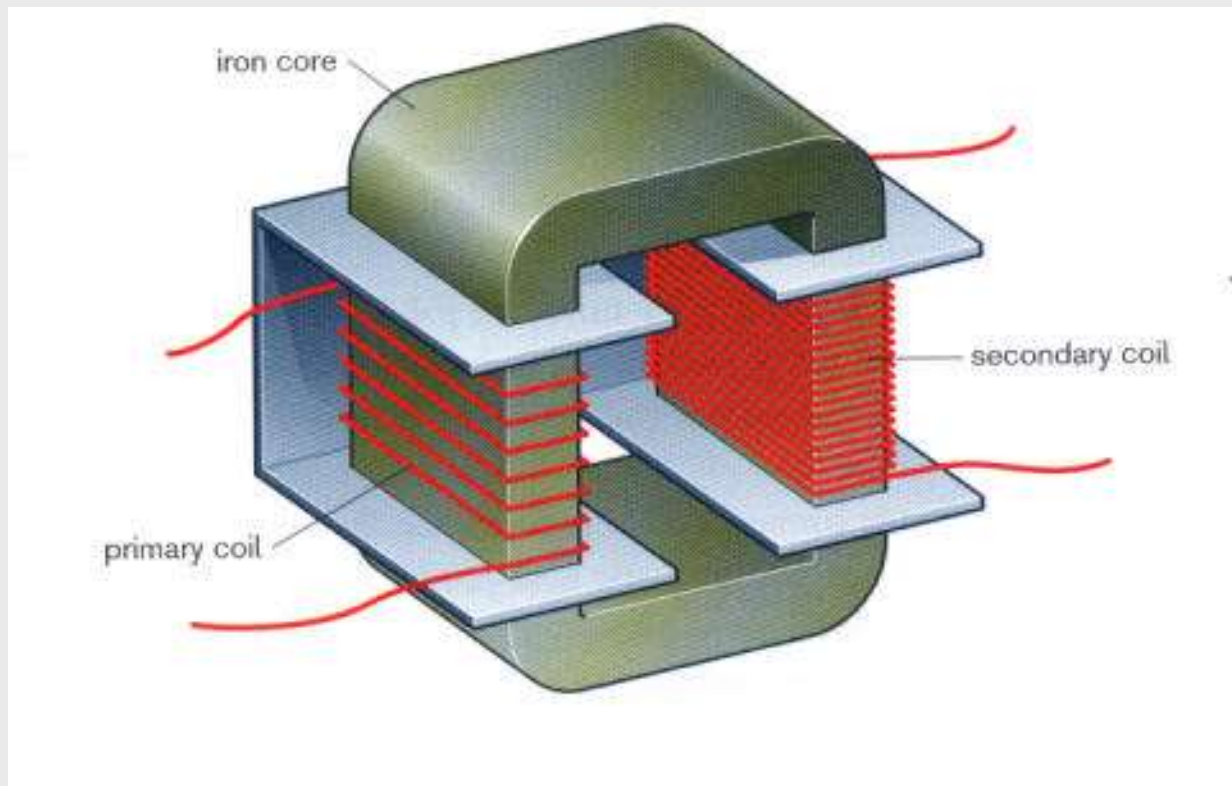


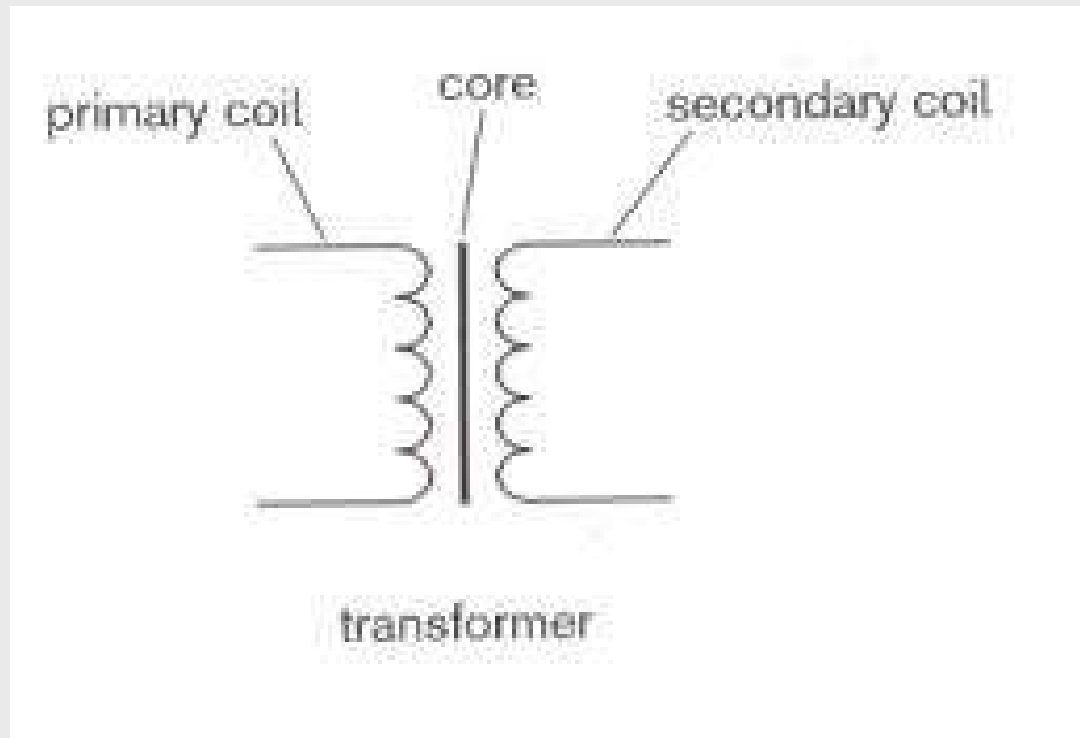
Transformers

A transformer is a device for increasing or decreasing an a.c. voltage.

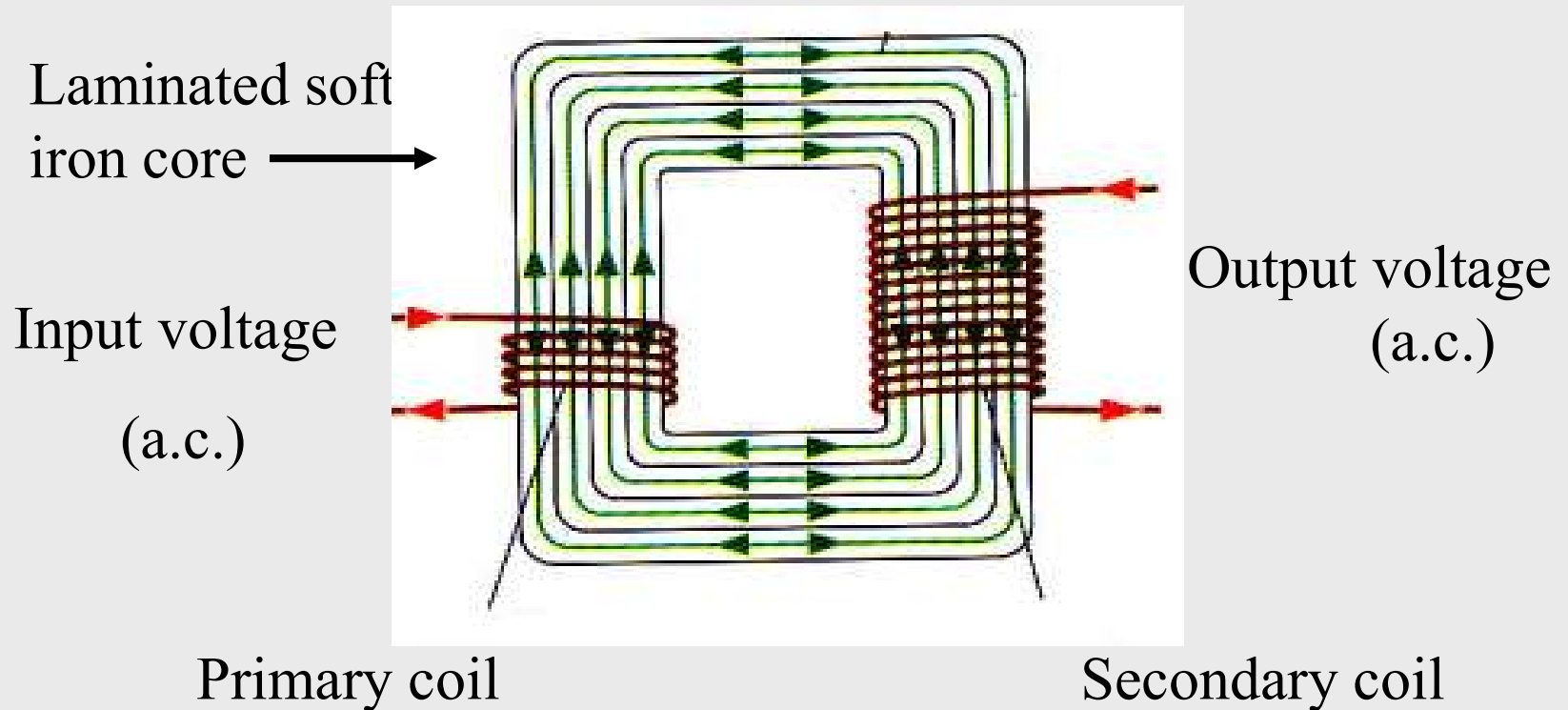
Structure of Transformer



Circuit Symbol for Transformer



How Transformer works



All transformers have three parts:

1. *Primary coil* – the incoming voltage V_p (voltage across primary coil) is connected across this coil.
2. *Secondary coil* – this provides the output voltage V_s (voltage across the secondary coil) to the external circuit.
3. *Laminated iron core* – this links the two coils **magnetically**.

Notice that there is no electrical connection between the two coils, which are constructed using insulated wire.

Two Types of Transformer

A **step-up transformer** increases the voltage - there are more turns on the secondary than on the primary.

A **step-down transformer** decreases the voltage - there are fewer turns on the secondary than on the primary.

To step up the voltage by a factor of 10, there must be 10 times as many turns on the secondary coil as on the primary. The **turns ratio** tells us the factor by which the voltage will be changed.

Formula for Transformer

$$\frac{\text{voltage across the primary coil}}{\text{voltage across the secondary coil}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

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

Where V_p = primary voltage

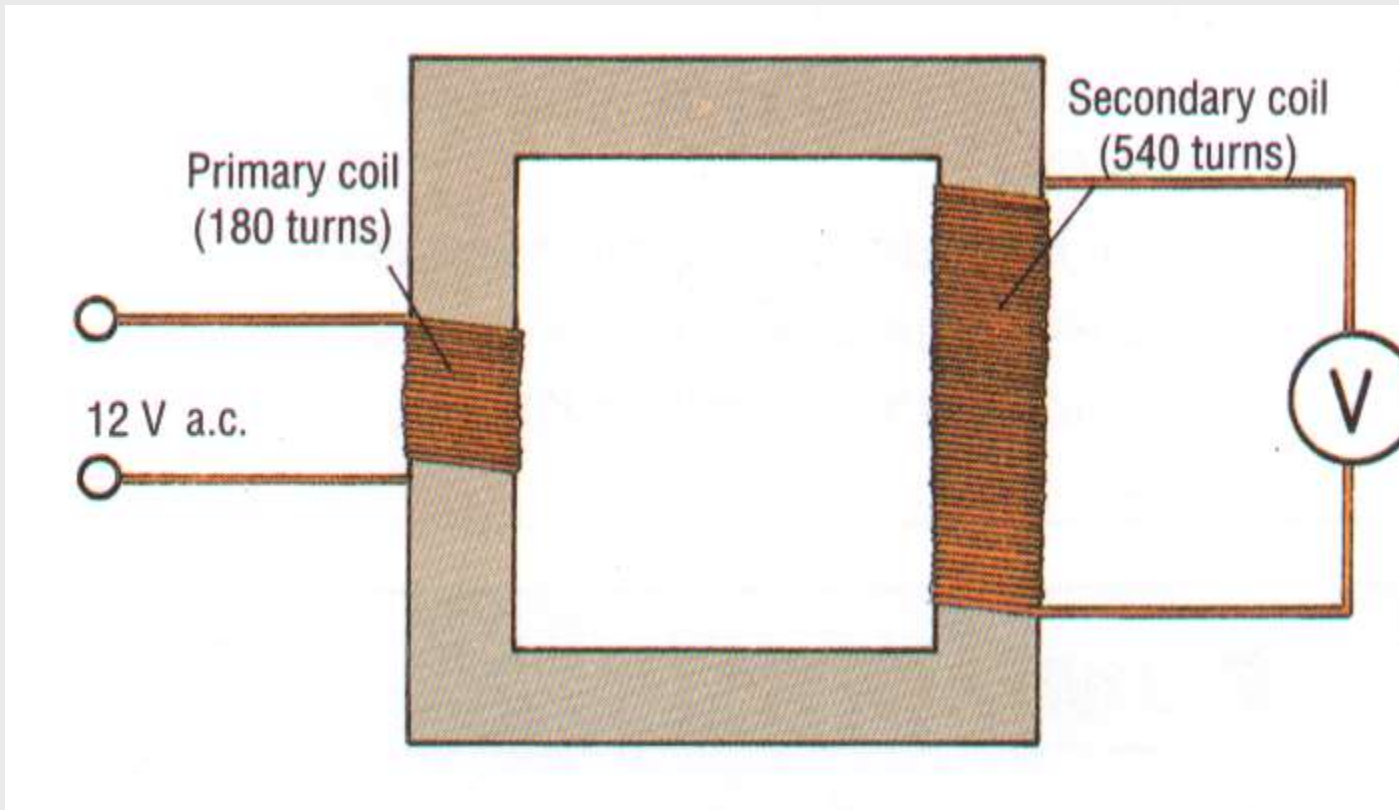
V_s = secondary voltage

N_p = Number of turns in primary coil

N_s = Number of turns in a secondary coil.

Worked example No. 1

The diagram shows a transformer. Calculate the voltage across the secondary coil of this transformer.



Step-up transformer!

Solution

$$\frac{V_P}{V_S} = \frac{N_P}{N_S}$$

Substituting

$$\frac{12}{V_S} = \frac{180}{540}$$

Crossmultiplying

$$180 \cdot V_S = 12 \times 540$$

$$\therefore V_S = \frac{12 \times 540}{180}$$

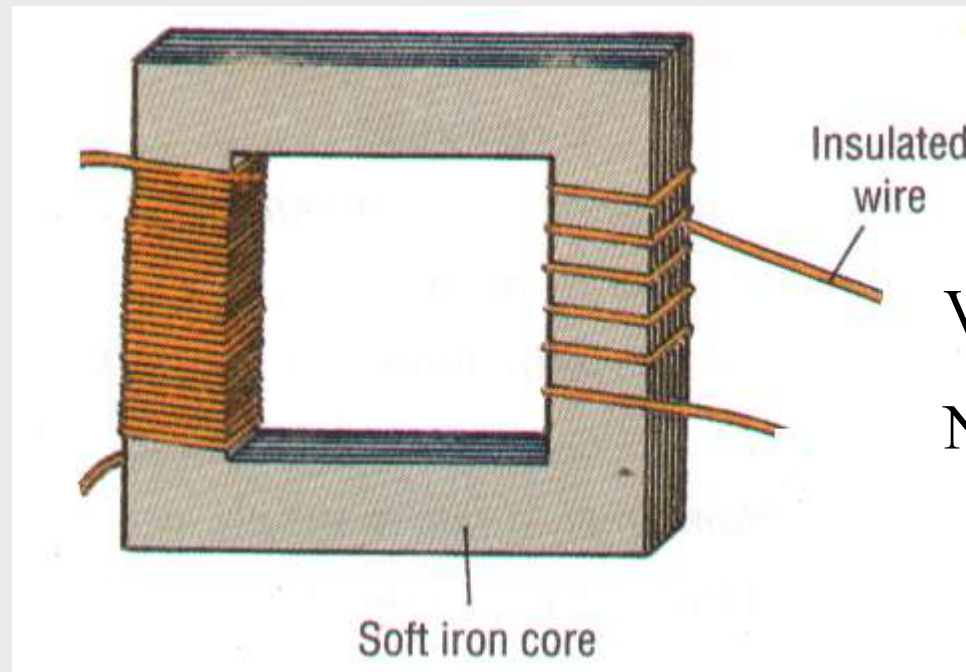
$$\therefore V_S = 36 \text{ V}$$

Worked example No. 2

A transformer which has 1380 turns in its primary coil is to be used to convert the mains voltage of 230 V to operate a 6 V bulb. How many turns should the secondary coil of this transformer have?

$$V_P = 230 \text{ V}$$

$$N_P = 1380$$



$$V_S = 6 \text{ V}$$

$$N_S = ?$$

Obviously, a Step-down transformer!!

Solution

$$\frac{V_P}{V_S} = \frac{N_P}{N_S}$$

Substituting

$$\frac{230}{6} = \frac{1380}{N_S}$$

Crossmultiplying

$$2300 \cdot N_S = 6 \times 13800$$

$$\therefore N_S = \frac{6 \times 1380}{230}$$

$$\therefore N_S = 36 \text{ turns}$$