A power plant might generate a certain amount of power and want to transmit to somewhere a long way away. Say a power plant generates a certain amount of electric power (P).

a) If it is transmitted at a voltage V, what is the formula for the current in the power line?

$$P = IV \rightarrow I = \frac{P}{V}$$

b) Some power will be lost to heat in the transmission line, if the total resistance is R write a formula for total power lost in the line.

$$P_{loss} = IV = I(IR) = I^2R = \left(\frac{P}{V}\right)^2 R = \frac{P^2R}{V^2}$$

c) Write a formula for power lost as a percentage of power sent.

$$\frac{P_{loss}}{P} = \frac{PR}{V^2}$$

d) The resistance of a power line is $6.43 \times 10^{-7}\ \Omega$ per metre. What will the total resistance be for a 100.0 km line?

$$6.43 \times 10^{-7} \times 1000 \times 100 = 0.0643\ \Omega$$

e) If we generated 120 kW of Power at a plant, determine the percent of power lost as a percentage of power sent if it is sent at 120V

$$\% = \frac{(120\,000)(0.0643)}{(120)^2} = 0.54 \rightarrow 54\%\ \text{loss}$$

f) Determine the percentage of power lost as a percentage of power sent if it is sent at 1 200 V.

$$\% = \frac{(120000)(0.0643)}{(1200)^2}$$

$$= 0.0054$$

$$= 0.54\%\ \text{loss}$$

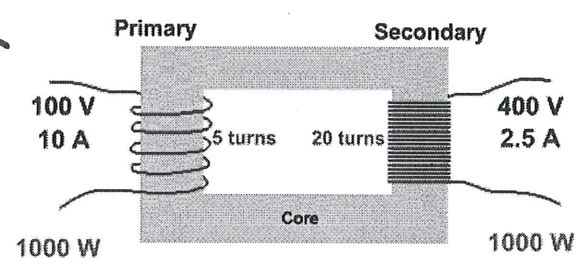
For long distance transmission it is important to have very high voltage, however having this high voltage in our homes would be very dangerous, so we need a method to change or __transform__ the voltage.

A transformer consists of a __primary__ coil and a __secondary__ coil.

As current flows through the primary coil it produces a __magnetic__ __field__. This magnetic field then induces an __electric__ __current__ in the secondary coil.

Transformers work for __AC__ current.

## Step Up Transformer



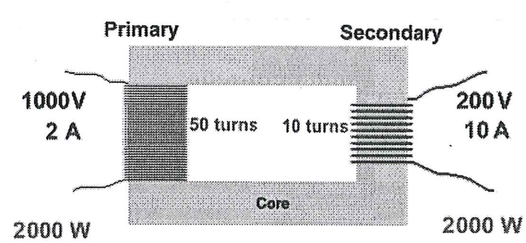

When a transformer increases voltage it is called a

Step Up Transformer

A step up transformer has

less coils in primary and more in secondary

## Step Down Transformer




When a transformer decreases voltage it is called a

Step Down Transformer

A step down transformer has

More loops in primary and less in secondary

To determine voltage change we use the formula

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

$V_p$ = primary voltage
$V_s$ = secondary voltage
$N_p$ = loops in primary
$N_s$ = loops in secondary

Though voltage is changed energy is always conserved so power is also conserved.

This gives us

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

Example 1: A step-up transformer is used to convert 120V to $1.50 \times 10^4$ V. If the primary coil has 24 turns, how many turns does the secondary coil have?

$$\frac{120}{1.5 \times 10^4} = \frac{24}{x} \rightarrow x = 24\left(\frac{1.5 \times 10^4}{120}\right)$$

$$= 3000 \text{ loops}$$

Example 2: A step-down transformer reduces the voltage from a 120 V to 12.0 V. If the primary coil has 500 turns and draws $3.00 \times 10^{-2}$ A,

a) What is the power delivered to the secondary coil?

$$P_s = P_p = (120)(3 \times 10^{-2}) = 3.6\text{W}$$

b) What is the current in the secondary coil?

$$\frac{I_s}{I_p} = \frac{V_p}{V_s} \rightarrow \frac{x}{3 \times 10^{-2}} = \frac{120}{12}$$

$$= 0.30\text{A}$$