Part A: short circuit test
Objectives:

To know short circuit test and why it used on single phase transformer, here why we use this test:

- To determine the parameters of the equivalent circuit.
- To determine the copper losses.
- To determine the impedance of the transformer.

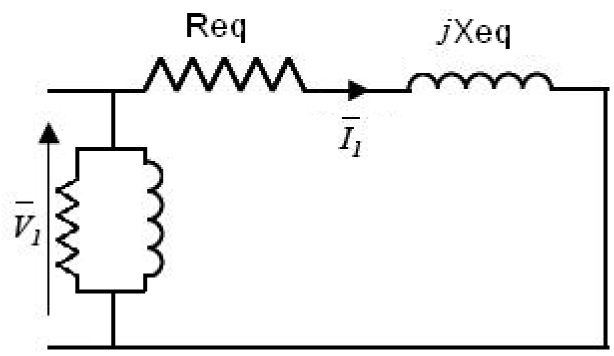
Introduction and theory:

The name of short circuit comes from that in this test the secondary of the transformer has to short circuited at the time that a very low voltage is applied on the primary, therefore the losses of V^2/R_m and V^2/R_x are neglected.

The winding impedance referred to primary:
$Z_{eq(sc)} = V_{1(sc)} / I_{1(sc)}$

The winding impedance referred to primary:
$R_{eq}=Z_{eq} * \cos 0$

The winding impedance referred to primary:
$X_{eq}= Z_{eq} * \sin 0$



Equivalent circuit of a transformer referred to primary

Part B: load test
Objectives:

- Directly load the transformer to curry out the load test.
- Finding the efficiency and the voltage regulation for a transformer.

Introduction and theory:

In this test, various load levels are applied to the secondary while a supply voltage is applied to the primary, and the actual efficiency of a transformer is determined by:

$\eta\% = P_{out}/P_{in} * 100\%$
Where $P_{out} = Re\{V.* I^{*}\}$

The theoretical is:
$\eta\% = P_{out}/ P_{out}+P_{iron}+P_{cu} *100\%$
$P_{iron} = |V_1|^2/R_m$
$P_{cu} = |I_2|^2 * R_{eq}$
Where P_{iron} and P_{cu} are the iron and copper losses.

When $P_{cu} = P_{iron}$ then, the transformer has a maximum efficiency, and the current responsible for this:

$I_2 = a. V_1 / (R_m.R_1)^{0.5}$

Voltage regulation: a measure of the drop voltage for on-load transformer:
$VR = |V_{2(no-load)}| - |V_{2(on-load)}| / |V_{2(on-load)}|$

Procedure:

Part A:

An error is exists because of the accuracy of the measurement device.

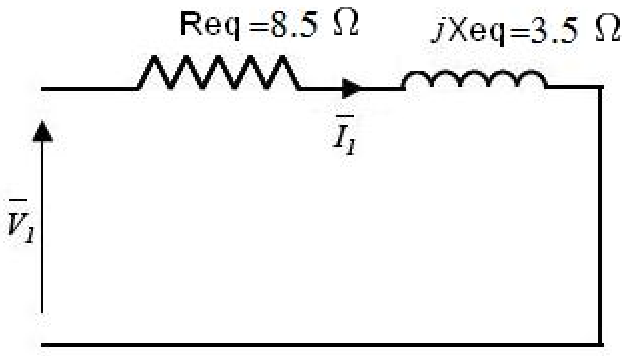
$I_{1(sc)}$ (A)	$V_{1(sc)}$ (v)	$W_{1(sc)}$ (W)	Cos 0	Z_{eq}	R_{eq}	X_{eq}
1.2	11	12	0.91	9.17	8.35	3.76
1.0	9	8.5	0.94	9	8.46	3.06
0.8	7	5	0.89	8.75	7.78	3.94
0.6	5	3	1	8.33	8.33	0

Calculations:

Cos 0= P/V.I=12/11 *1.2=0.91	Z=V/I= 9.17	0=24.5	sin0=0.41
Cos 0= P/V.I=8.5/9*1=0.94	Z=9/1=9	0=19.95	sin0=0.34
Cos 0= P/V.I=5/7*0.8=0.89	Z=7/0.8=8.75	0=27.12	sin0=0.45
Cos 0= P/V.I=3/5*0.6=1	Z=5/0.6=8.33	0=0	sin0=0

Q1) why a short circuit test is done on the on the transformer in LV winding shorted and supply given to the HV side?

Q2) draw the equivalent circuit of the transformer including the values of the parameter.



Part B:

I_1(A)	P_1 (W)	V_2 (v)	I_2(A)	P_2 (W)	η%
1.2	261	100	2.62	229	87.77%
1.0	222	102	1.91	196	88.29%
0.8	177	103	1.50	157	88.70%
0.6	132	105	1.11	117	88.64%

Calculations:

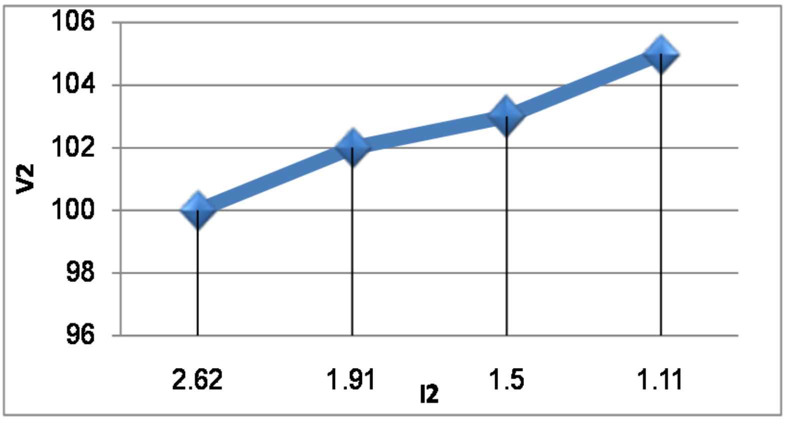
$\eta\% = P_{out}/P_{in} * 100\% = 229/261 = 87.77\%$

$\eta\% = 196/222 * 100\% = 88.29\%$

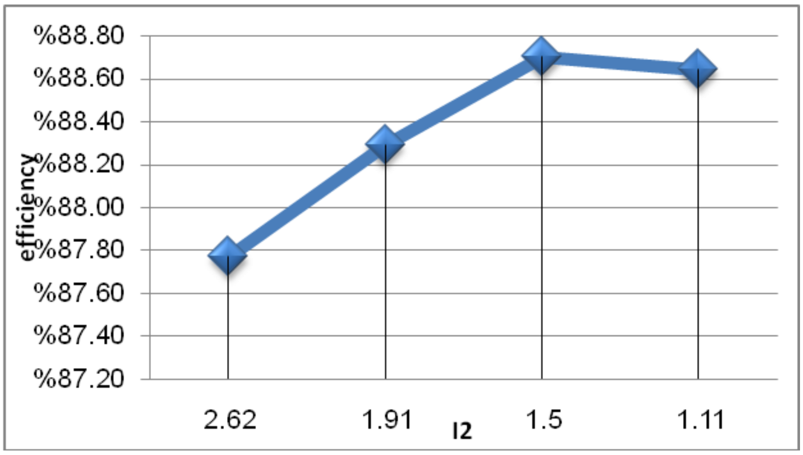
$\eta\% = 157/177 * 100\% = 88.70\%$

$\eta\% = 117/132 * 100\% = 88.64\%$

1- plot V2 versus I2:



2- Plot efficiency versus I2:



Q1) is the active power P_1 less than the active power P_2? What is the function of the no load current?

Q2) why will the transformer consumes more current when it's loaded?

Conclusions:

- In voltage transformer the load affects the value of I_2.
- The input power is greater than the output power because of losses.
- When applying the short circuit test on a transformer, the value of the short circuit current is very high.
- A phase angle between the primary and secondary is because of the reactance of the windings and the magnetization branch.
- The short circuit test is used to find the values of the parameters.
- VR% is a measure of the drop in voltage between load and no load conditions.