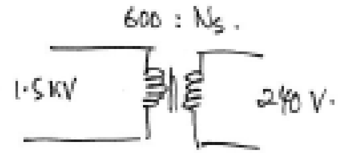
Solution Tutorial 5 (Transformer)

①.



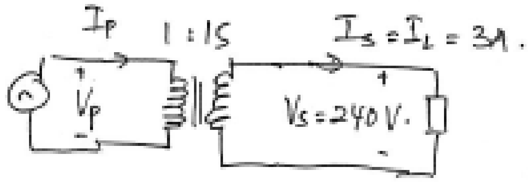
Assuming no losses:

$$P_{in} = P_{out}.$$

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

$$\therefore N_s = \frac{V_s}{V_p} N_p = \frac{240}{1500} \times 600 = 96$$

②.



Neglect losses;

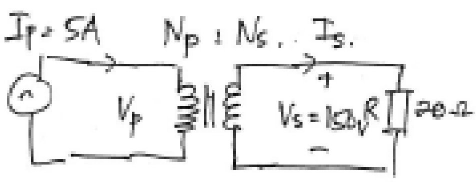
$$\therefore V_p = \frac{N_p}{N_s} \times V_s = \frac{1}{15} \times 240 = 16\,V$$

$$P_{in} = P_{out}$$

$$V_p I_p = V_s I_s.$$

$$\therefore I_p = \frac{V_s I_s}{V_p} = \frac{240 \times 3}{16} = 45\,A$$

③.



Neglecting losses:

$$P_{in} = P_{out}$$

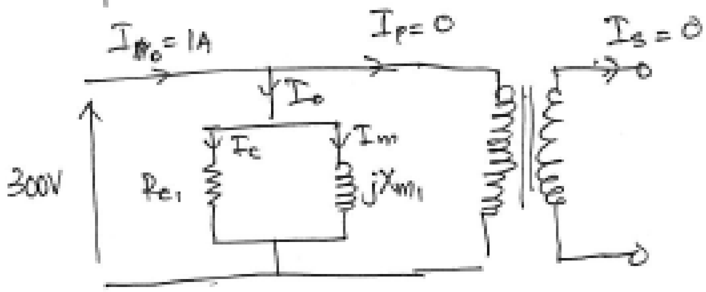
$$V_p \times I_p = \frac{V_s^2}{R} = \frac{150^2}{20} = 1125\,W$$

$$\therefore V_p = \frac{1125}{5} = 225\,V \qquad ; I_p = 5A$$

$$\therefore \text{Turns ratio, } \frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{225}{150} = \frac{3}{2}$$

(4)

For open circuit - Test:



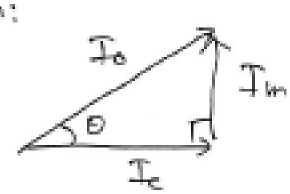
$P_o = 120W$

a.) Iron loss current

$$P_o = I_c^2 \times R_{e1}$$
$$= (I_c \times R_{e1}) I_c$$
$$120 = 300 \times I_c$$
$$\therefore I_c = \frac{120}{300} = 0.4A$$

b.) The power factor on no-load;

phasor diagram:



$$pf = \cos\theta = \frac{I_c}{I_o} = \frac{0.4}{1.0} = 0.4$$

c.) The magnetizing current:

$$I_m = \sqrt{(I_o^2 - I_c^2)}$$
$$= \sqrt{1^2 - 0.4^2} = 0.92$$

5

a) $\frac{V_2}{V_1} = \frac{N_2}{N_1}$

$\frac{24}{240} = \frac{50}{N_1}$

$N_1 = 500$.

b) $S_1 = V_1 I_1$

$2k = 240\, I_1$

$\therefore I_1 = 8.33A$.

$\frac{V_2}{V_1} = \frac{I_1}{I_2}$

$\frac{24}{240} = \frac{8.33}{I_2}$

$\therefore I_2 = 83.3A$.

c) $E_1 = 4.44\, N_1 f\, \Phi_m$

$240 = 4.44\, (500)(50)\, \Phi_m$

$\therefore \Phi_m = 2.162\ mWb$.

6

a) $5n^2 = 3$

$n = 0.7746$

o/p ~~kVA~~ at max eff

$= 0.7746 \times 500k$

$= 387.3\ kVA$.

b) Total loss at max eff.

$3k + 3k = 6kW$

$o/p = 387.3k \times 0.85$

$= 329.205\ kW$.

c) i/p power = o/p power + total loss

$= 329.205\ kW + 6kW$

$= 335.209\ kW$.

Max eff $= 1 - \frac{6}{335.205}$

$= 98.21$