AL-IMAM MOHAMMAD IBN SAUD ISLAMIC UNIVERSITY
ELECTRIC DRIVES
MID I EXAM– SEMESTER 2, 1437/1438

COLLEGE OF ENGINEERING
Electrical Engineering Dept.
Time allowed 1 hr and 15 minutes
MONDAY 20/3/2017

Exam Score: /20

اسم الطالب............ Model Answer

Try the following Problems

Problem I /4

The magnetic circuit shown has the following:

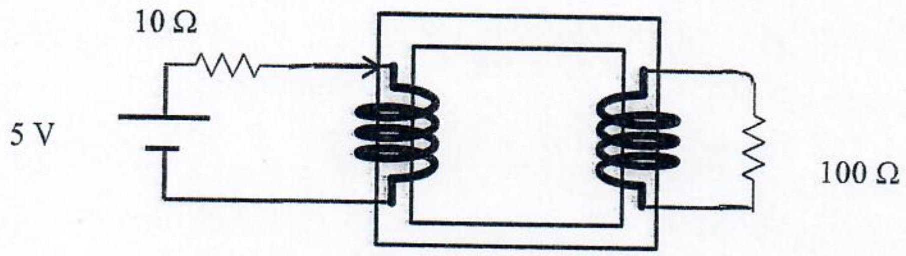
$N_1 = 50$ turns, $N_2 = 20$ turns, iron core length, $l_c = 40$ cm

iron core cross section area = 4cmx4cm where $\mu_r = 50000$

Coil 1 connected to a 5V battery and resistor 10 Ω and coil 2 is connected to a 100 Ω resistance. Find

(a) L_{12}

(b) Power delivered by the battery at steady state



$$L_{12} = \frac{\mu_0 \mu_r N_1 N_2 A_c}{L_c} = \frac{4\pi \times 10^{-7} * 50{,}000 * 50 * 20 * 16 \times 10^{-4}}{40 * 10^{-2}}$$ (2)

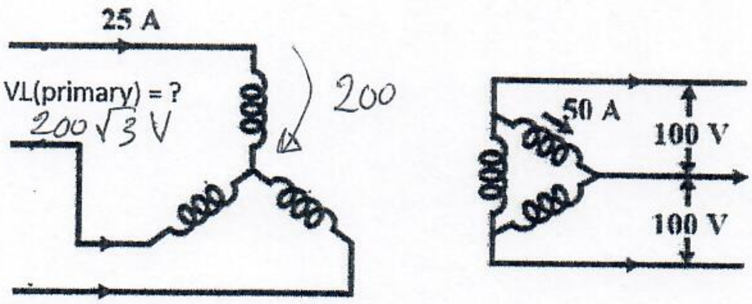
$= 251$ mH

@ steady state $P = \frac{V^2}{R} = \frac{25}{10} = 2.5$ W (2)

Problem II

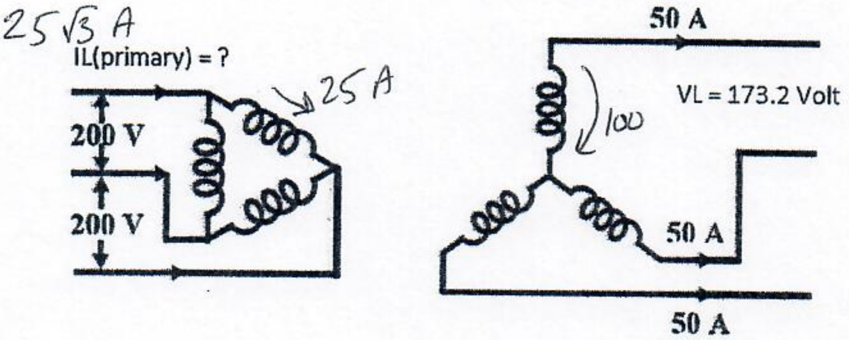
/6

In the following 3 phase ideal transformers, supply the missing line and phase currents and voltages



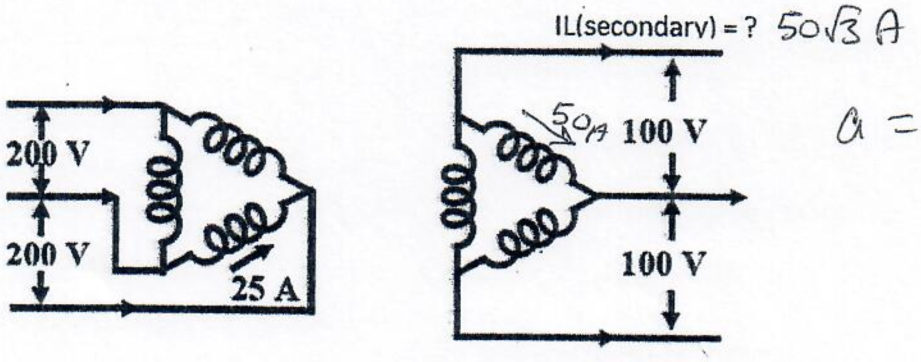
$a = 2$

(1.5)



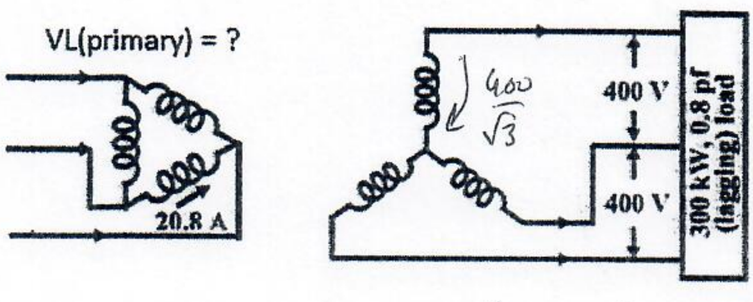
$a = 2$

(1.5)



$a = 2$

(1.5)



$300 * 10^3 = \sqrt{3} * 400 * I_L * 0.8$

$I_L = 541.3$ A

$a = \frac{541.3}{20.8} = 26$

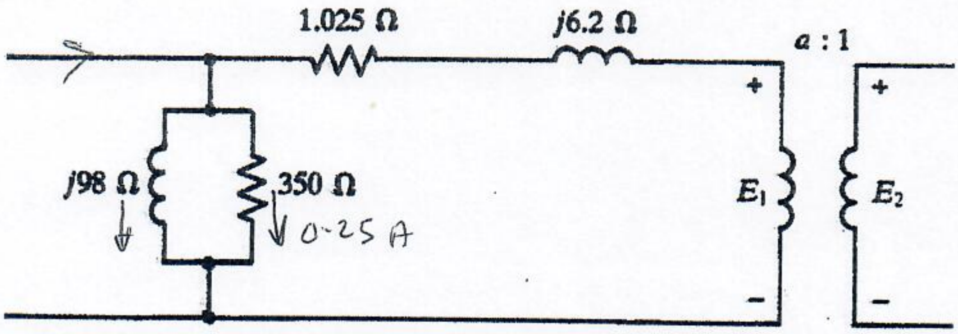
$V_{L\,pri} = 26 * \frac{400}{\sqrt{3}} = 6004$ V

(1.5)

Problem III

/4

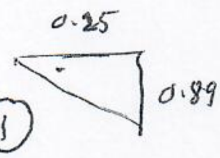
For the transformer equivalent circuit shown, the secondary is open circuit, a =5, and the current in the 350 Ω is 0.25A. Find V_1, V_2, I_1, I_2, total power losses, and the transformer efficiency η.



$V_1 = 0.25 * 350 = 87.5 \angle 0$ V (1/2)

$i_X = \frac{87.5}{98} = 0.89 \angle -90$ A

$i_1 = 0.25 \angle 0 + 0.89 \angle -90 = 0.92 \angle -74.3^\circ$ A (1)



$i_2 = 0$ (1/2)

$E_1 = V_1$

$E_2 = V_2 = \frac{1}{5} * 87.5 \angle 0 = 17.5 \angle 0$ V (1/2)

total power loss $= (0.25)^2 * 350 = 21.9$ W (1)

$\eta = 0$ (1/2)

Problem IV

/6

A single-phase 1000/200 V transformer undergoes two tests:

(i) The primary no-load current is 3 A at 1000 V and a power factor of 0.2 lagging.

(ii) The primary current is 24 A at 1000 V and a power factor of 0.7 lagging when the secondary current is 100 A at 200 V and a power factor of 0.8 lagging.

Assuming iron loss is the same in the two tests, find:

(a) Iron loss

(b) Copper loss in each case

(c) The transformer efficiency in each case

$a = 5$

(i) iron loss = $3 * 1000 * 0.2 =$ **600 W** (1) & **Copper loss = 0** (1)

(ii) input power = $24 \times 1000 * 0.7 =$ **16800 W**

output power = $100 * 200 \times 0.8 =$ **16000 W**

$\sum$ losses = **800 W** (1)

∴ Copper loss = $800 - 600 =$ **200 W** (1)

$\boxed{\eta_1 = 0}$ (1)

$\eta_2 = \frac{1600}{16800} \times 100 = \boxed{95.2\ \%}$ (1)