UEE30811 Certificate III Electrotechnology Electrician

Solve problems in single and three phase low voltage machines

Transformers
TEST 1A

Time allowed – One Hour

14 Pages in this Question Booklet

Student Feedback / Comments

The results of my performance have been discussed and explained to me.
Student: | | **Date:** |
If you would like to request a review of your results or if you have any concerns about your results, contact your teacher or head teacher.
Teacher: | | **Date:** |

TOTAL MARKS AVAILABLE

SECTION	Possible Marks	Actual Marks
A	**20**	
B	**20**	
C	**20**	
TOTAL	**60**	

Instructions to Students:

- **Electronic devices are to be turned off and removed from your person.** You cannot access an electronic device during this examination.
- All questions are to be answered in the space provided in this Question Booklet. Answers to Section A – Multi-choice Questions, are to be recorded on the Answer Sheet attached to this Question Booklet.
- You are not to use any reference book in this examination.
- The whole of this Question Booklet is to be handed to the Supervisor upon completion.

Aids permitted where indicated:

Standard Dictionaries	Bilingual Dictionaries	Technical Dictionaries	Programmable Calculators	Non-programmable Calculators	Mobile Phones	MP3 Players
No	**Yes**	**No**	**No**	**Yes**	**No**	**No**

Section A - Multiple Choice (20 Marks)

Select the most appropriate answer from the choices provided with each question.
Write your answer in the space provided on the answer sheet.
Each question is worth 1 mark.

1. Transformer laminations are manufactured from:

   (a) copper
   (b) corrosion – resistant steel
   (c) cold rolled silicon steel
   (d) iron

2. The winding that is connected to the supply is known as the:

   (a) secondary winding
   (b) auxiliary winding
   (c) armature winding
   (d) primary winding

3. If a transformer's heat dissipation is increased:

   (a) the efficiency of the transformer will improve
   (b) the efficiency of the transformer will decrease
   (c) the rating of the transformer will increase
   (d) the transformer will produce more 'hum'

4. The secondary voltage of a transformer is produced by:

   (a) self induction
   (b) mutual induction
   (c) thermo – dynamic induction
   (d) electrostatic induction

5. The iron loss of a distribution transformer is 400 W at full load, what is the iron loss at half full load:

   (a) 100 W
   (b) 200 W
   (c) 300 W
   (d) 400 W

6. A transformer fitted with oil pumped cooling banks and air fans would have its cooling method designated as:

   (a) ONAN
   (b) ONAF
   (c) ONAN/ONAF
   (d) OFAF

7. A transformers' rating is determined by:

   (a) the viscosity of the transformer oil
   (b) the size of the conductors used in the windings
   (c) the type of material used for conductors
   (d) the ability to dissipate heat

8. If the load on a transformer increases the secondary amps:

   (a) decrease and the primary increase
   (b) increase and the primary amps remains the same
   (c) increase and the primary amps increase
   (d) increase and the primary amps decrease

9. The copper loss of a distribution transformer is 1600 W at full load. What is the copper loss at half full load?

   (a) 1600 W
   (b) 800 W
   (c) 400 W
   (d) 200 W

10. In a transformer the component of *no load* current which lags the primary voltage by 90^{o} is the:

    (a) magnetising current
    (b) iron loss current
    (c) secondary current
    (d) primary current

11. The primary and secondary windings of a double wound transformer are:

    (a) both electrically and magnetically isolated
    (b) electrically linked but mechanically isolated
    (c) magnetically linked but electrically isolated
    (d) both electrically and magnetically linked

12. With an increasing non-inductive load the secondary terminal voltage of a transformer would:

    (a) remain unchanged
    (b) rise slightly
    (c) fall slightly
    (d) become unstable

13. The efficiency of a transformer:

    (a) is constant over a wide range
    (b) varies with the load
    (c) varies with the iron losses
    (d) has a maximum of 90%

14. Transformers are usually rated in:

(a) watts
(b) reactive volt-amps
(c) watt-hours
(d) volt-amps

15. The oil used for insulating and cooling transformers is:

(a) olive oil
(b) vegetable oil
(c) peanut oil
(d) mineral oil

16. An oil filled transformer which is cooled by means of fans blowing air across the radiators on the tank is known as:

(a) ONAN
(b) OFAF
(c) OFAN
(d) ONAF

17. A transformer that has more turns on the secondary winding than the primary winding is known as:

(a) step down transformer
(b) step up transformer
(c) isolating transformer
(d) current transformer

18. The short circuit test on a transformer is used to determine the:

(a) apparent losses
(b) reactive losses
(c) copper losses
(d) iron losses

19. The drop in voltage of the secondary terminal from no load to full load of a transformer is the:

(a) combined primary and secondary impedance voltage drop
(b) secondary impedance voltage drop
(c) reactive voltage drop
(d) resistive voltage drop

20. The main function of oil in a transformer is to:

(a) dissipate the heat produced in the windings
(b) insulate the windings from the tank
(c) grease the windings when overloaded
(d) prevent the iron laminations from oxidising

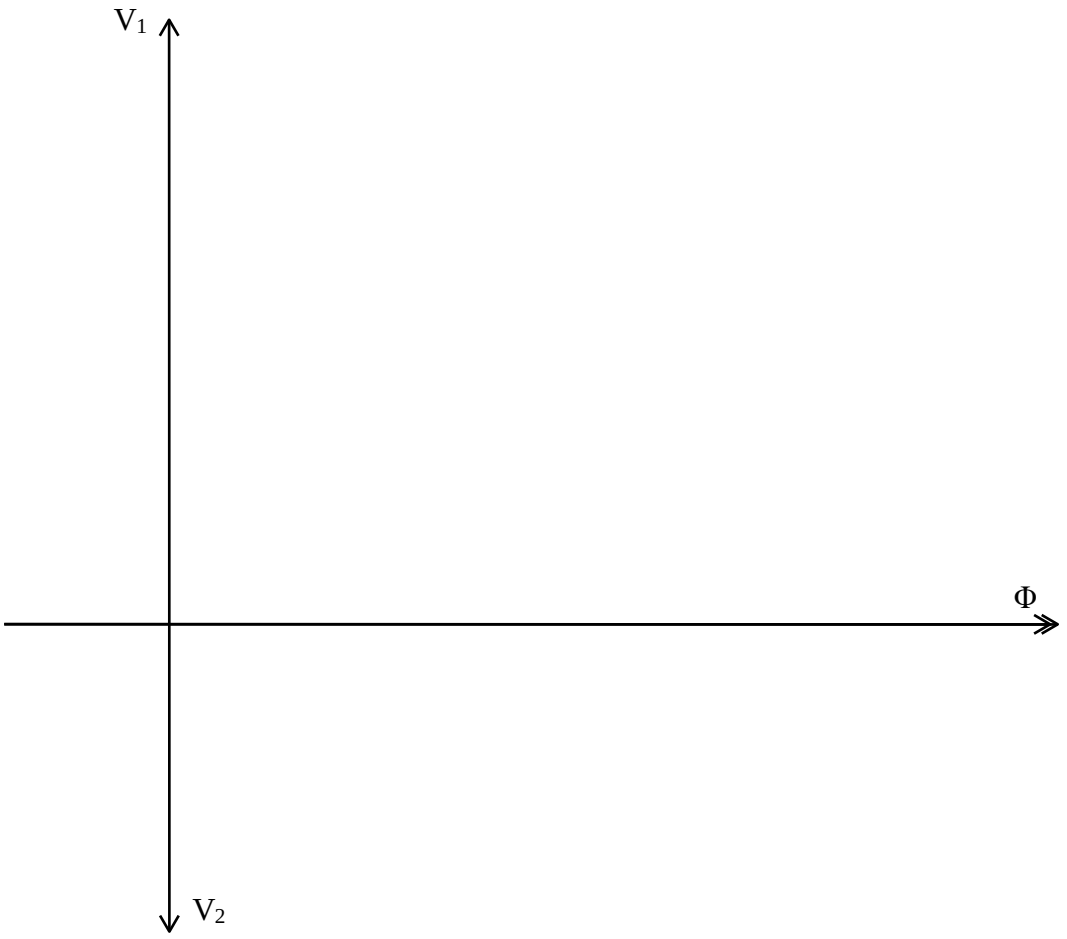
Section B - Drawings, Diagrams and Short Answer (20 Marks)

Write the answers for the following calculations in the space provided. Show all working. Marks allocated, are shown adjacent to each question.

1. Draw to scale a phasor diagram to determine the primary current and primary phase angle from the specifications given below.

Primary Turns	600	No Load Current	2A
Secondary turns	300	No Load Phase Angle	80^0
		Secondary Current	10A
		Secondary Phase Angle	30^0

(5 Marks)



a) Measured Primary Current. _____

b) Measured Phase Angle. _____

2. Given the primary voltage, the number of coil turns of a transformer and load resistance as shown in diagram (A) below, connect the secondaries in diagrams B, C and D to give the load currents shown.

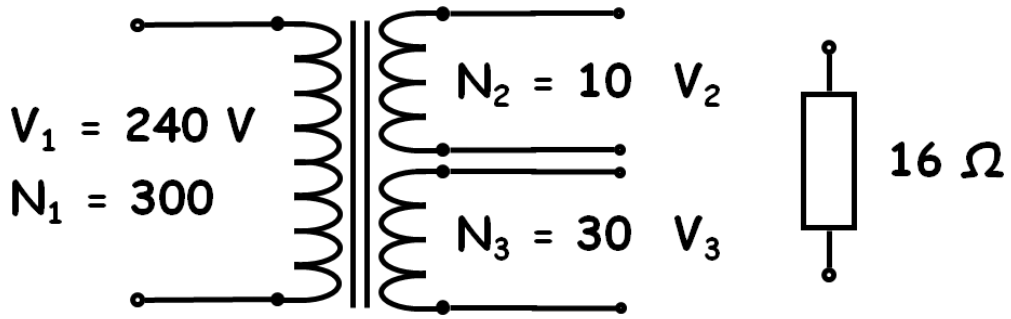


Diagram A

Note: Instantaneous secondary polarities are shown in diagrams B, C and D.

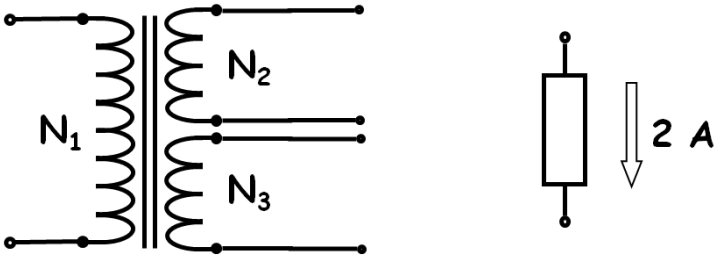


Diagram B

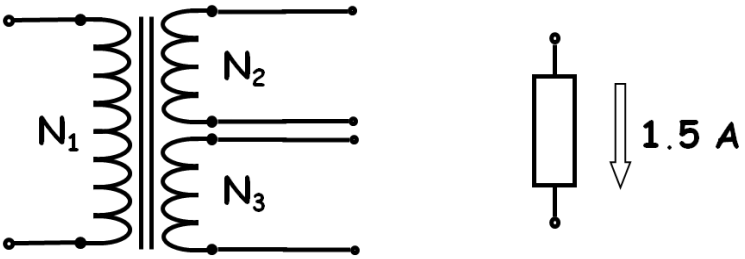


Diagram C

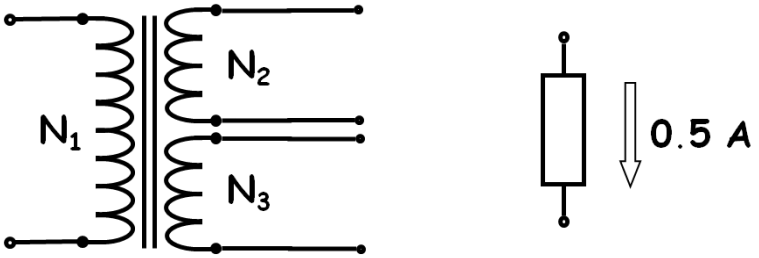
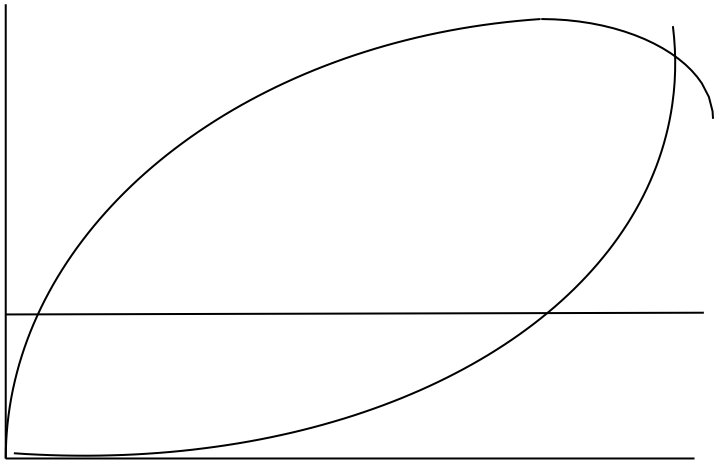


Diagram D

(3 Marks)

3. The following diagram shows the relationship between the losses and efficiency. Mark clearly on the graph the following;

- Iron losses
- Copper losses
- Efficiency
- Load axis
- Draw a line which represents maximum efficiency



(5 Marks)

4. State the cooling method for the transformer below and its correct annotation.

Cooling method

_____

_____

Symbols Used

(2 Marks)

5. To determine the iron losses of a transformer state;

(2 Marks)

a) what test is carried out_____

b) what voltage is applied to the transformer_____

6. In a step down transformer which winding would have the largest CSA and explain why.

(2 Marks)

_____

_____

7. State the recommended current drawn from the low voltage winding of a 240/20 volt, 200VA transformer.

(1 Mark)

_____

Section C - Calculations(20 Marks)

Write the answers for the following calculations in the space provided. Show all working. Marks allocated, are shown adjacent to each question.

1. A single phase 230 V to 15 V step down transformer is connected to a 5 ohm resistive load. Neglecting losses, determine:

   (a) the current taken by the load
   (b) the primary current
   (c) the power output of the transformer with the connected load of 5 ohms

(6 Marks)

2. A 500 kVA, 11 kV/400V transformer is short circuited on the secondary side. A reduced voltage of 600 V is applied to the primary winding, so that a full load current flows in the secondary winding. Determine the percentage impedance of the transformer.

(3 Marks)

4. A transformer has a no load secondary voltage of 240 V and a full load secondary voltage of 230 V. What is the percentage voltage regulation of the transformer?

(3 Marks)

5. A 1000 kVA, 11 kV/400 V has the following test results:

Copper loss: 12 kW
Iron loss: 1.5 kW

Determine:

(a) the efficiency at full load at unity power factor. (2 Marks)
(b) the efficiency at half full load at unity power factor. (4 Marks)

(6 Marks)

6. A transformer with a core flux of 8mWb has a primary winding of 900 turns. Calculate the primary voltage if the transformer operates on a 50Hz supply.

(2 Marks)

END

Note: The symbols used on this sheet follow AS1046 pt 1. There are alternate recognised symbols in use. The list does not contain every equation used in the course. Transposition of equations will be necessary to solve problems

$$Q = It \qquad v = \frac{s}{t} \qquad a = \frac{\Delta v}{t}$$

$$F = ma \qquad W = Fs \qquad W = mgh$$

$$W = Pt \qquad \eta\% = \frac{output}{input} \times \frac{100}{1} \qquad I = \frac{V}{R}$$

$$P = VI \qquad P = I^2R \qquad P = \frac{V^2}{R}$$

$$R_2 = \frac{R_1 A_1 l_2}{A_2 l_1} \qquad R_h = R_c(1 + \alpha \Delta t) \qquad R = \frac{\rho l}{A}$$

$$R_T = R_1 + R_2 + R_3 \qquad V_T = V_1 + V_2 + V_3 \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$I_T = I_1 + I_2 + I_3 \qquad V_2 = V_T \frac{R_2}{R_1 + R_2} \qquad I_2 = I_T \frac{R_1}{R_1 + R_2}$$

$$R_x = \frac{R_A R}{R_B} \qquad C = \frac{Q}{V} \qquad \tau = RC$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \qquad C_T = C_1 + C_2 + C_3 \qquad C = \frac{A \varepsilon_o \varepsilon_r}{d}$$

$$F_m = IN \qquad H = \frac{F_m}{l} \qquad B = \frac{\Phi}{A}$$

$$\Phi = \frac{F_m}{S} \qquad S = \frac{l}{\mu_o \mu_r A} \qquad V = N \frac{\Delta \Phi}{\Delta t}$$

$$e = Blv \qquad L = \frac{\mu_o \mu_r A N^2}{l} \qquad L = N \frac{\Delta \Phi}{\Delta I}$$

$$V = L \frac{\Delta I}{\Delta t} \qquad \tau = \frac{L}{R} \qquad F = Bil$$

$$T = Fr \qquad E_g = \frac{\Phi Z n P}{60a} \qquad P = \frac{2\pi n T}{60}$$

$$t = \frac{1}{f} \qquad f = \frac{np}{120} \qquad V = 0.707 V_{\max}$$

$$I = 0.707 I_{\max} \qquad V_{ave} = 0.637 V_{\max} \qquad I_{ave} = 0.637 I_{\max}$$

$$v = V_{\max} \sin \phi \qquad i = I_{\max} \sin \phi \qquad I = \frac{V}{Z}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad X_L = 2\pi f L \qquad X_C = \frac{1}{2\pi f C}$$

$$\cos\phi = \frac{P}{S} \qquad \cos\phi = \frac{R}{Z} \qquad S = \sqrt{P^2 + Q^2}$$

$$S = VI \qquad P = VI\cos\phi \qquad Q = VI\sin\phi$$

$$f_o = \frac{1}{2\pi\sqrt{LC}} \qquad V_L = \sqrt{3}V_P \qquad I_L = \sqrt{3}I_P$$

$$S = \sqrt{3}V_L I_L \qquad P = \sqrt{3}V_L I_L \cos\phi \qquad Q = \sqrt{3}V_L I_L \sin\phi$$

$$\tan\phi = \sqrt{3}\left(\frac{W_2 - W_1}{W_2 + W_1}\right) \qquad Q = mC\Delta t$$

$$V' = 4.44\Phi fN \qquad \frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad \frac{I_2}{I_1} = \frac{N_1}{N_2}$$

$$N_{syn} = \frac{120f}{p} \qquad s\% = \frac{(n_{syn} - n)}{n_{syn}} \times \frac{100}{1} \qquad f_r = \frac{s\% \times f}{100}$$

$$V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{FL}} \times \frac{100}{1} \qquad V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{NL}} \times \frac{100}{1} \qquad T = \frac{\Phi ZIP}{2\pi a}$$

$$I_{ST} = \frac{1}{3} \times I_{DOL} \qquad T_{ST} = \frac{1}{3} \times T_{DOL} \qquad I_{ST} = \frac{V_{ST}}{V} \times I_{DOL}$$

$$T_{ST} = \left(\frac{V_{ST}}{V}\right)^2 \times T_{DOL} \qquad I_{motor\,st} = \frac{\%TAP}{100} \times I_{DOL} \qquad I_{line\,st} = \left(\frac{\%TAP}{100}\right)^2 \times I_{DOL}$$

$$E = \frac{\Phi_v}{A} \qquad E = \frac{I}{d^2} \qquad \eta_v = \frac{\Phi_v}{P}$$

$$V_L = 0.45V_{ac} \qquad V_L = 0.9V_{ac} \qquad V_L = 1.17V_{phase}$$

$$V_L = 1.35V_{line} \qquad PRV = \sqrt{2}V_{ac} \qquad PRV = 2\sqrt{2}V_{ac}$$

$$PRV = 2.45V_{ac} \qquad V_{ripple} = \sqrt{2}V_{ac} \qquad V_{ripple} = 0.707V_{phase}$$

$$V_{ripple} = 0.1895V_{line}$$

Student Name : _____

Class : _____

ANSWER SHEET

Section A (Multi-choice Questions)

Instructions:

Enter your personal details in the top right hand corner of this sheet.
Place an **X** in box of your choice. If you make a mistake, circle your answer ⊗ and choose again.

Question	A.	B.	C.	D.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Totals				

Total Marks Section A: _____