(b) A 250 kVA, three-phase, delta-star-connected step-down transformer has a phase-turns ratio of 217 to 1. The primary is connected to a 50 kV, three-phase supply, and the transformer is fully loaded. Calculate:

i. the secondary phase voltage **(2 marks)**
ii. the secondary line voltage **(2 marks)**
iii. the primary line current **(2 marks)**
iv. the secondary line current **(2 marks)**
v. State ONE reason why a current transformer is dangerous when its secondary winding is left in the open-circuit condition. **(2 marks)**

6. (a) A three-phase, 400 V, 50 Hz, 4 pole squirrel-cage induction motor when running fully loaded has:

- Full load speed (FLN) 1440 rpm
- Efficiency (η) 90 %
- Power factor (pf) 0.86

The load requires a full-load torque of 66.315 Nm. at 1440 rpm.
Using the information above calculate:

i. the output power of the motor in kW **(2 marks)**
ii. the input power of the motor in kW **(2 marks)**
iii. full-load current the motor will draw **(2 marks)**
iv. the synchronous speed of the motor **(2 marks)**
v. the percentage (%) slip of the motor **(2 marks)**

(b) Calculate the line current drawn by a three-phase, 400V inductive load of 19 kW at a power factor of 0.875. **(2 marks)**

(c) An alternator has 48 poles and is to feed into the 230/400V, 50 Hz TPN distribution system. Calculate the speed of rotation of the alternator to enable it to feed into the distribution system. **(2 marks)**

(d) Define the term impedance as it applies to an a.c. circuit. **(1 mark)**

(e) Impedance is comprised of three components. State TWO of those components. **(1 mark)**

(f) On a switchboard of a low voltage electrical installation, protective devices were installed that have a rupturing capacity lower than the prospective short circuit current rating of the installation. State what could occur if there was a short-circuit fault on the electrical installation. **(2 marks)**

(g) Explain why a 500 kVA transformer is able to operate at a heavier load when used in a low ambient temperature environment, than when it is used in a high ambient temperature environment. **(2 marks)**

END OF PAPER

EXAMINATION: AUTHORISATION B
July 2018

Paper I (Theory)

Time Allowed: 3 Hrs

WRITE ALL YOUR WORK IN THE ANSWER BOOK PROVIDED. EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY DIAGRAMS AND FORMULAE.

START EACH ANSWER ON A FRESH PAGE.

Answer any **FIVE** Questions

1. A three-phase 2200/240 volts, 50 Hz star/delta transformer is to be designed. The following information is given:

   - Cores are to be of square cross-section
   - The maximum flux density is 1.1 Wb/m^2
   - The induced emf is 12 volts per turn
   - The emf equation is E = 4.44 B.A.f.N volts

   (a) Find the dimensions of the core allowing 10% for the insulation between stampings. **(10 marks)**
   (b) Find the number of turns on the high tension side. **(5 marks)**
   (c) Find the number of turns on the low tension side. **(5 marks)**

2. A shunt motor takes a current of 30 Amp. The armature resistance is 0.2 Ω and the shunt field resistance is 100 Ω. The iron and friction losses are 500 W.

   (a) Draw a well-labelled diagram of the arrangement **(2 marks)**
   (b) Find he total losses in the machine **(6 marks)**
   (c) Find the b.h.p. of the machine **(6 marks)**
   (d) Find the commercial efficiency of the machine **(6 marks)**

3. Three 230V single-phase loads are supplied from a 400V 50Hz 3-phase 4-wire supply. The loads supplied are as follows:

   - 10kW at unity power factor connected between L1 and neutral.
   - 15kVA at 0.8 lagging power factor connected between L2 and neutral.
   - 8kVA at 0.7 lagging power factor connected between L3 and neutral.

   (a) Draw a diagram showing the connected load. **(2 marks)**
   (b) Calculate:
   i. The current in each line conductor **(5 marks)**
   ii. The current in the neutral conductor **(10 marks)**
   iii. Draw a neat and detailed phasor diagram **(3 marks)**

4. (a) State Kirchhoff's laws as applied to an electrical circuit. **(4 marks)**
   (b) For the bridge circuit shown in Figure 1 using Kirchoff's laws find:
   i. The current flowing in the 3Ω resistor **(6 marks)**
   ii. The current flowing in the 6Ω resistor **(4 marks)**
   iii. The current flowing in the 5Ω resistor **(6 marks)**

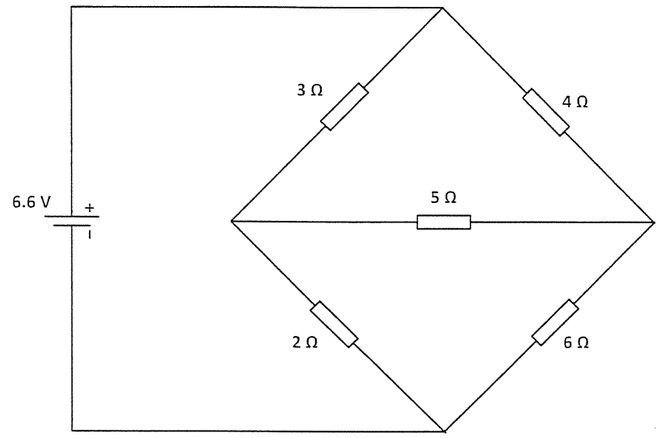

Figure 1

Figure 1

5. (a) A nameplate of a three-phase, 4-pole induction motor has the following information:

Frequency:	50 Hz
Line voltage:	400V
Line Current:	unknown
Power rating:	10kW
Efficiency:	81.5%
Slip:	4%

The line current lags the voltage by a phase angle of 35^0. Calculate:

   i. the power factor of the motor. **(1 mark)**
   ii. the input power of the motor. **(2 marks)**
   iii. the line current of the motor. **(2 marks)**
   iv. the slip speed of the motor. **(3 marks)**
   v. the rotor speed of the motor. **(2 marks)**