6. A storage battery is made up of 50 cells in series. The battery is to be charged at a constant rate of 40 amperes from a 220 volt supply.

The e.m.f. per cell before the start of charge is 2-2 volts and at the end of the charge the e.m.f. rises to 2.5 volts per cell.

The internal resistance of each cell is 0.006 ohm.

What resistance must be placed in series with the battery to keep the charging current constant at 40 amperes?

a) At the start of charging. **(6 marks)**

b) At the end of charging. **(6 marks)**

c) What percentage of the total energy developed is actually used to charge the battery? **(6 marks)**

d) Draw a diagram of the arrangement. **(2 marks)**

END OF PAPER

Scan

EXAMINATION: AUTHORISATION B
February 2017

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 coil of inductance 162.34 mH and a resistance 50Ω is connected in parallel with a 30μF capacitor, across a 230V, 50 Hz supply. Sketch the circuit and phasor diagrams and calculate:
   a) The current in the coil and its phase angle. **(6 marks)**
   b) The current in the capacitor and its phase angle. **(5 marks)**
   c) The supply current and its phase angle. **(5 marks)**
   d) The circuit impedance. **(2 marks)**
   e) The power consumed. **(2 marks)**

2. a) Define Kirchhoff's Laws i.e. current law and voltage law. **(4 marks)**

   Refer to Figure 1:

   b) Re draw Figure 1 and assume that the current flows from the positive terminals of the batteries. Label ALL branch currents flowing. **(4 marks)**

   c) Use Kirchhoff's laws to determine the currents flowing in each branch of the network. **(12 marks)**

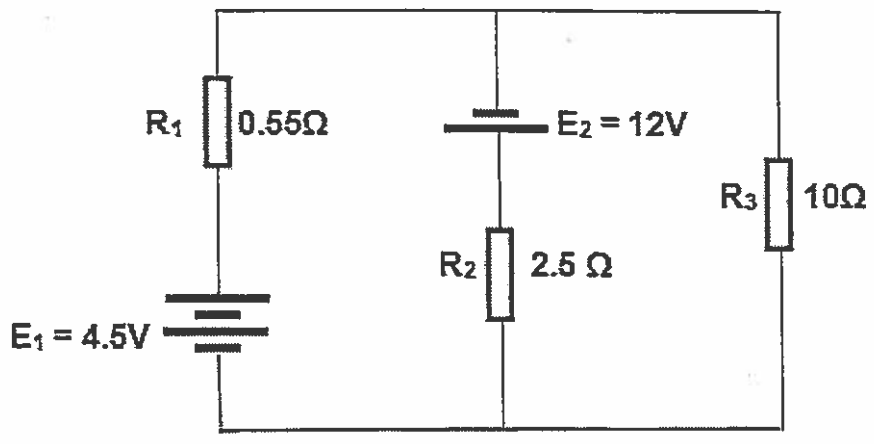

Figure 1

3. a) Deduce the E.m.f. equation for a transformer **(6 marks)**

   b) Explain why the ferrous magnetic circuits subject to alternating magnetism are usually laminated and give examples of typical core construction for three phase transformers. **(4 marks)**

   c) A 40kVA has a core loss of 450W and full-load copper losses of 850W. If the power factor of the load is 0.8, calculate:

      i. The full load efficiency **(5 marks)**

      ii. The maximum efficiency assuming the power factor of the load remains 0.8 **(5 marks)**

4. a) State and briefly describe four types of losses which occur in a DC machine **(5 marks)**

   b) Draw the Torque / Speed characteristic for a series motor and a shunt motor **(2 marks)**

   c) A series motor runs at 800 rev / min when the supply voltage is 400 V DC and draws a current of 25 A from the supply. The armature resistance is 0.4 Ω and the series field resistance is 0.2 Ω: Determine the resistance to be connected in series with the motor to reduce the speed to 600 rev / min with the motor still continuing to draw a current of 25 A from the supply. **(13 marks)**

5. The power input to a 250 h.p, 1100 volt, three-phase motor running at full load is measured by two watt-meters which read, 145 KW and 62 KW respectively. Calculate:

   a) the input power. **(4 marks)**

   b) the p.f. **(5 marks)**

   c) the line current. **(5 marks)**

   d) the efficiency. **(4 marks)**

   e) Draw a diagram showing how the watt-meters are connected to the motor. **(2 marks)**