

6. a) State Ohm's Law as applied to a direct current (D.C.) circuit (2 marks)

b) A circuit consisting of three resistors of resistances  $12\Omega$ ,  $16\Omega$  and  $48\Omega$  connected in parallel, in series with a fourth resistor of resistance  $R$  ohms. The whole combination of resistances is connected to a 60 Volt direct current supply and it is found that the power dissipated in the  $12\Omega$  resistor is 48 Watts.

Draw the circuit showing the resistors' combination. (3 marks)

c) Calculate:

- i. The current taken by each resistor (8 marks)
- ii. The value of the fourth resistor  $R$  (3 marks)
- iii. The total power dissipated in the whole circuit (4 marks)

**END OF PAPER**

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**EXAMINATION: AUTHORISATION A**

Paper I (Theory)

Time Allowed - 3Hrs

July 2017

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**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.**

Choose any FIVE questions.

1. An electric washing machine is tested to find its efficiency. The following are the test results:

Water	= 36 litres
Temperature at start of test	= 18 °Celsius
Temperature at end of test	= 100 °Celsius
Supply Voltage	= 240 Volts
Current	= 14.5 Amperes
Time taken to heat the water	= 1.25 hours
Specific heat capacity of water	= 4187 J (Kg °C)

- Find:
- Find the heat energy expended in Joules. (4 marks)
  - Find the heat energy in KWH (4 marks)
  - Find the input power of the machine. (4 marks)
  - Find the output power of the machine. (4 marks)
  - Determine the efficiency of the machine. (4 marks)

- 2.
- Identify the losses in a single-phase transformer and state how they vary with the load. (4 marks)
  - Make a simple line diagram of a single phase double wound transformer. Show the Earthing arrangements of such a transformer. (5 marks)
  - Make a simple line diagram of a single phase auto transformer. Show the Earthing arrangements of such a transformer. (5 marks)
  - A transformer has a step-down ratio of 20:1. Its primary winding consists of 2000 turns. Calculate:
    - the number of secondary turns. (3 marks)
    - the secondary voltage when the primary is supplied at 240 volts. (3 marks)

3. a) Explain what is meant by the following terms when related to alternating current circuit .
- reactance, (2 marks)
  - impedance, (2 marks)

- b) An adjustable resistor, R ohms is connected in series with a capacitor of  $5\mu\text{F}$  across an alternating voltage supply. The current taken from the supply was measured to be 1.6 Amperes and the supply frequency was measured to be 50Hz.

Draw the circuit showing the circuit configuration. (2 marks)

- c) Calculate
- The value of the resistance R in order that the voltage across the capacitor shall be half that of the supply voltage (6 marks)
  - The power taken by the circuit (3 marks)
  - The power factor of the circuit (3 marks)
  - Sketch a phasor diagram showing all the voltages across the circuit. (2 marks)

4. a) Three  $12\mu\text{F}$  capacitors are connected in series across a 750V supply. Calculate
- The equivalent circuit capacitance (2 marks)
  - The charge on each capacitor (2 marks)
  - The potential difference across each capacitor. (6 marks)

- b) Capacitances of  $1\mu\text{F}$ ,  $3\mu\text{F}$ ,  $5\mu\text{F}$  and  $6\mu\text{F}$  are connected in parallel to a direct voltage supply of 100V. Determine:
- The equivalent circuit capacitance (2 marks)
  - The total charge (2 marks)
  - The charge on each capacitor (6 marks)

5. a) Explain the following:
- Primary cells
  - Secondary cells (4 marks)
- b) The EMF of a cell is measured as 2.1 V, and its terminal p.d. as 1.9 V when it carries a current of 5 A. Calculate the internal resistance of the cell. (6 marks)
- c) A set of nine cells, each of EMF 2.4 V and an internal resistance of 0.05 ohm are connected in three banks of three cells in series. The three banks are then connected in parallel with each other and with a resistor of 1.9 ohms.
- Draw the cell arrangement for the above (4 marks)
  - Calculate the current flowing in the resistor (6 marks)