
EXAMINATION: AUTHORISATION A

Paper I (Theory)

Time Allowed - 3Hrs

JULY 2015

**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. (a) Explain the meaning of the following terms as applied to an illumination scheme:
 - Utilisation factor, (2 marks)
 - Maintenance factor, (2 marks)
 - Illumination. (2 marks)

- (b) An office measuring 20m by 45m requires an illumination at desk level of 330 lux. The lighting fittings selected to illuminate the office contains 80-W fluorescent tubes. The manufacture catalogue specifies that when the fittings are new, each fitting provides 4800 lumens. The mounting height of the fittings above desk level will be 2m. Assuming a Utilisation factor of 0.6 and a Maintenance factor of 0.85. Calculate,
 - i. The number of lighting fittings required to illuminate the office, (5 marks)
 - ii. The annual cost of electricity if the lighting fittings are used on average 5 days a week and 12 hours daily. Assume that the office is supplied from a single phase supply and that the cost of electricity is 17 cents per kWh. (9 marks)

2. (a) Determine the p.d. across a $10\mu\text{F}$ capacitor when charged with 5mC. (6 marks)

- (b) Find the charge on a 100 pF capacitor when the voltage applied to it is 2.5 kV. (7 marks)

- (c) A direct current of 5A flows into a previously uncharged $50\mu\text{F}$ capacitor for 4ms. Determine the p.d. between the plates. (7 marks)

3. (a) Explain with the aid of a diagram, the principle of the Wheatstone Bridge. (5 marks)

- (b) A balanced Wheatstone Bridge consists of four terminals A, B, C, D, to which are connected the following resistors:
 - Resistor of $15\ \Omega$ between A and B,
 - Resistor R_x between B and C,
 - A variable resistor reading $8\ \Omega$ when the bridge is balanced between C and D,
 - Resistor of $12\ \Omega$ between D and A.

The battery supplying the bridge is 30V and is connected between terminals A and C, while the galvanometer is connected between B and D.

- i. Draw a labelled diagram showing the Wheatstone Bridge configuration, (5 marks)
- ii. If the Wheatstone Bridge is balanced when the variable resistance is set to 8Ω , find the value of the Unknown Resistor R_x , (5 marks)
- iii. Calculate the voltage across each resistor. (5 marks)

4. (a) Write the formula for heat energy. (3 marks)

(b) What is the specific heat capacity of water? (3 marks)

(c) How many joules make up 1kWh of energy? (3 marks)

(d) An old 3.5 kW water boiler is only 78% efficient. If it is used to raise 50 litres of water from 18 degrees Celsius to boiling point find:

- i. The heat in joules required to heat the water. (2 marks)
- ii. The energy consumed during the operation. (2 marks)
- iii. The time taken to heat the water. (3 marks)
- iv. The cost of the operation if energy costs 11 euro cents per unit. (4 marks)

5. (a) Express Ohm's law in words and symbols. (2 marks)

(b) Resistor A, of 25 ohms is connected in parallel to resistor B of unknown value. The group is connected in series to a third resistor C of 5 ohms. If the voltage across C is 80 volts and the power dissipated in the whole circuit is 3.84 kW.

i. Draw a well-labelled circuit diagram. (2 marks)

Calculate:

ii. The value of resistor B. (4 marks)

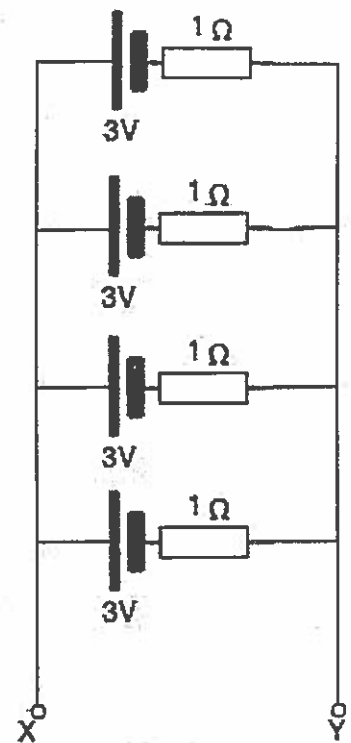
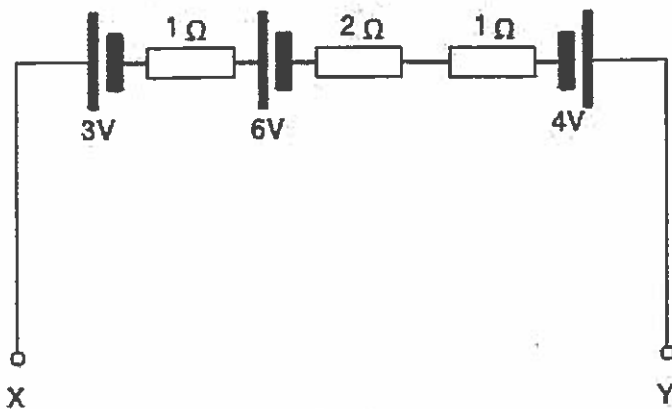
iii. The circuit voltage. (4 marks)

iv. The current taken by each resistor. (4 marks)

v. The value of another resistor that must be connected in parallel with the whole combination so that the total circuit current will be increased by 100%. (4 marks)

6(a) For the circuits shown in Fig. 2 and Fig 3 below the resistors represent the internal resistance of the batteries. Find, in each case: (12 marks)

- i. the total e.m.f. across XY
- ii. the total equivalent internal resistances of the batteries.



(b) Ten 1.5V cells, each having an internal resistance of 0.2Ω , are connected in series to a load of 58Ω . Determine

- iii. the current flowing in the circuit and
- iv. the p.d. at the battery terminals.

(8 marks)

END OF PAPER