



6. A $30\mu\text{F}$ capacitor is connected in parallel with an $80\ \Omega$ resistor across a 230 V, 50 Hz supply.

a) Draw and label the circuit diagram for the above combination. **(2 marks)**

b) Calculate:

- i) the current in each branch, **(3 marks)**
- ii) the supply current, **(3 marks)**
- iii) the circuit phase angle, **(3 marks)**
- iv) the circuit impedance, **(3 marks)**
- v) the power dissipated, and **(3 marks)**
- vi) the apparent power. **(3 marks)**

Total: 100 marks

EXAMINATION FOR AUTHORISATION B
Paper 2

Date: 9th February 2023

Time: 15:30 – 18:30 (Three hours)

END OF EXAMINATION PAPER

This examination paper contains six questions. Candidates are requested to answer any FIVE (5) questions. Candidates are also requested to include all their work in the booklet provided. Every answer should include all workings, any necessary diagrams and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. A new electrical installation is to be installed in a carpenter's workshop having a parking area for customers and employees. The following loads will be connected:

Item	Quantity	Description
General Lighting	45	twin 125 W 230 V fluorescent luminaries at 0.6 pf
External Lighting	12	300 W 230 V floodlights at 0.7 pf
AC Motors	6 2	single-phase motors, 3.5 kW each at 0.8 pf three-phase motors, 2.5 kW 400 V each at 0.85 pf
Spray Boot	1	5 kVA, 400 V at 0.8 pf

The supply available from the utility is a 400 V 50 Hz four-wire system.

- a) Calculate:
- the total load per phase assuming the load is distributed on all phases. **(10 marks)**
 - the rating of the main Moulded Case Circuit Breaker (MCCB) with the provided ratings in Table 1.1. A 25% Future Growth Factor must be considered. **(3 marks)**
- b) What size of Distribution Board would you recommend for this installation? The Distribution Board sizing is given in Table 1.2. **(7 marks)**

Rating (A) I_n	40	63	100	125	160

Busbar Rating (A)	200	200	200	200	200
3P Ways	4	6	8	12	18

2. a) Mention and explain how a passenger lift power and control system is protected for any missing phase or incorrect phasing. **(4 marks)**
- b) A three-phase lift is used to transport goods between the ground floor and the basement. At each location a call control panel is required. The control panel must have:
- two call buttons for the ground floor and the basement
 - an emergency stop button
 - two indication lamps showing where the lift is positioned.
- What type of motor starter is required to drive the goods lift? Explain how this operation is achieved using one motor. **(6 marks)**
 - Draw a circuit diagram for the motor starter control circuit indicating the control at each floor, emergency stops at both locations, limit switches to stop the motor, electrical interlocks and any electrical latching required. **(10 marks)**

3. Briefly describe the system of wiring you would adopt for the following installations and conditions. In your answer give reasons for your selection of the type of installation used.
- a Fireworks factory **(5 marks)**
 - a Petrol station **(5 marks)**
 - a Laundry **(5 marks)**
 - a Boiler room. **(5 marks)**

4. a) Briefly state some advantages of using a current and a voltage instrument transformer. **(5 marks)**
- b) A current transformer has a single turn on the primary winding and a secondary winding of 60 turns. The secondary winding is connected to an ammeter with a resistance of 0.15Ω . The resistance of the secondary winding is 0.25Ω . If the current in the primary winding is 300 Amps. Calculate:
- the reading on the ammeter **(3 marks)**
 - the potential difference across the ammeter **(4 marks)**
 - the total load in VA on the secondary **(3 marks)**
- c) What precautions must be observed when using current and voltage transformers? **(5 marks)**
5. a) Define **Temperature Coefficient** of resistivity (α). **(3 marks)**
- b) List the **four** factors that affect the resistance of an electrical conductor. **(4 marks)**
- c) A copper wire has a resistance of 200Ω at 20°C . A current is passed through the wire and the temperature rises to 90°C . Determine the resistance of the wire at 90°C , correct to the nearest Ω , assuming that the temperature coefficient of resistance is $0.004/^\circ\text{C}$ at 0°C . **(6 marks)**
- d) A car headlight filament is made of tungsten and has a cold resistance of 0.35Ω . If the filament is a cylinder 4 cm long (it may be coiled to save space). Calculate the diameter of the tungsten filament. **(3 marks)**
- e) For the above question (d) calculate the resistance of the tungsten filament if its temperature is increased from room temperature (20°C) to an operating temperature of 2850°C . **(4 marks)**

The Resistivity (ρ) for tungsten is: $5.6 \times 10^{-8} \Omega \text{ m}$.

The Temperature Coefficient of resistivity (α) is: $4.5 \times 10^{-3} /^\circ\text{C}$.