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GOVERNMENT OF MALTA
MINISTRY FOR EDUCATION
AND SPORTS

EXAMINATION FOR AUTHORISATION A

Paper 2

Date: Thursday 2nd July 2026

Time: Three hours

Write <u>only</u> your Index Number in the space provided in the booklet.

This examination paper includes six questions. Candidates are requested to choose and answer any FIVE questions clearly indicating the question number of the answered questions.

Candidates are requested to answer ALL FIVE questions in the booklet correctly listing the answered question number in the space provided on the booklet's front sheet.

Answers should be written in Blue/Black Ink. Diagrams can be drawn in pencil.

All answers should include the necessary workings, diagrams and formulae.

Use a separate page for each different question.

Each question carries 20 marks.

1. A single-phase transformer has a primary winding of 1200 turns and a secondary winding of 300 turns. The primary winding is connected to a 230 V 50Hz a.c. supply. At full load, the secondary current is 8 A. The total input power to the transformer at full load is 640 W.

   (a) State THREE types of transformer losses. (3 marks)

   (b) Calculate the:

   (i) secondary voltage (3 marks)

   (ii) primary current at full load (3 marks)

   (iii) output power at full load (4 marks)

   (iv) efficiency of the transformer at full load (4 marks)

   (v) total losses in the transformer. (3 marks)

2. (a) A single-phase 230 V, 50Hz supplying a load drawing 20 A through a copper cable. The cable route length between the distribution board and the load isolator is 30 metres. The cross-sectional area of each cable core is 6 mm². Considering the resistivity of copper, ρ, as $1.72 \times 10^{-8} \Omega \cdot m$.

   Calculate the:

   (i) resistance of the cable loop (2 marks)

   (ii) voltage drop in the cable. (1 mark)

   (b) state ONE effect of excessive voltage drop on an electrical installation. (2 marks)

   (c) A 20W fluorescent tube in a traditional luminaire is to be replaced with an LED tube. The supplier recommends installing the LED tube without modifying the luminaire wiring, but with the starter removed from its holder.

   The original fluorescent tube operated from a 230 V, 50Hz a.c. supply through a ballast (inductor or choke) and a starter.

   Calculate the:

   (i) current drawn by the original fluorescent lamp circuit, given that the voltage across the fluorescent tube during normal operation is 60V (4 marks)

   (ii) inductance of the ballast (3 marks)

   (iii) real power absorbed by the new LED system, given that the current has dropped to 150 mA (4 marks)

   (iv) power factor of both systems (original and new). (4 marks)

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6. The electrical installation of a two-bedroom apartment requires to be tested according to IET BS7671:2018 part 6 and SL 545.24.

(a) List FOUR instruments that are required to test the new installation. (4 marks)

(b) State the recommended period of re-testing according to SL 545.24. (1 mark)

(c) Mention

(i) THREE tests to be carried out **before** the supply is switched on (3 marks)

(ii) THREE tests to be carried out **after** the supply is switched on. (3 marks)

(d) The new installation is tested for the insulation resistance. **On your booklet** copy and complete the table below (Table 2). The table is according to IET BS7671:2018 regulation 643.3.2. (4marks)

Circuit nominal voltage (V)	**Test voltage DC (V)**	**Minimum insulation resistance in MΩ**
SELV and PELV		
Up to and including 500V with the exception of the above systems.		

Table 2 – Diversity factors

(e) In the lighting circuit of the two-bedroom apartment the insulation resistance value between conductors is 0.1Ω.

(i) State if If this insulation resistance reading is considered to be low. (1 mark)

(ii) List FOUR actions to be taken to improve the insulation resistance value if considered to be low. (4 marks)

END OF EXAMINATION PAPER

3. (a) According to Part 1 of BS 7671, state THREE types of electrical installations that fall within the scope of the Regulations. (3 marks)

(b) Since 2006, cable core colours for fixed wiring have been harmonised across Europe and the UK. State the new single-phase colours adopted. (3 marks)

(c) Identify the key boundaries of responsibility for

(i) Distribution System Operator (DSO) (3 marks)

(ii) Consumer. (3 marks)

(d) In accordance with BS 7671, a specific protected measure namely, undervoltage protection, is applied to a motor to prevent automatic restart after a power failure. For the undervoltage protection describe the

(i) method and (3 marks)

(ii) operation. (3 marks)

(e) According to the “Electrical Installation Regulations”, S.L. 545.24, in Malta, every consumer installation must be equipped with protective devices. State TWO of these mandatory devices. (2 marks)

4. A bill of quantities (BOQ) for a two-bedroom apartment is required to purchase electrical items from the local electrical hardware suppliers. The erection of the conduit and conduit fittings is excluded. Assume 230V, 50Hz and power factor 0.8.

(a) Compile a table showing the BOQ that includes

(i) the description and quantity of each item. The items are represented by the symbols shown in the layout in Diagram 1 overleaf. (10 marks)

(ii) the second part of the BOQ that includes the estimated length and cross-sectional area (CSA) of single core PVC insulated cables that are required for the rooms 1 & 2 radial circuit (area less than 50sqm) and ring-circuit for the rooms 4 and 5 shown in the layout in Diagram 1overleaf. (5 marks)

(iii) all components required to complete the consumer unit according to the Maltese law. (5 marks)

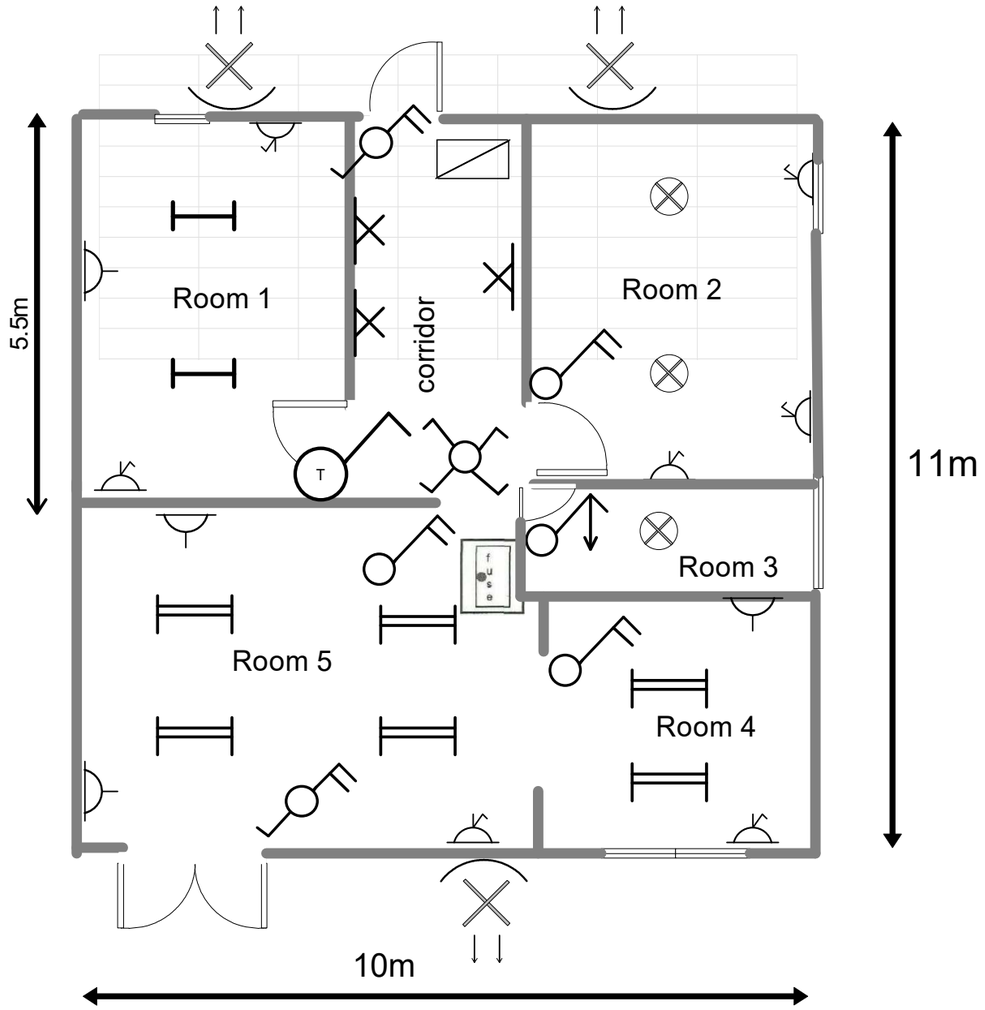


Diagram 1

5. (a) Explain the purpose of applying diversity factors when determining the maximum demand of an electrical installation. (3 marks)

(b) A domestic three-bedroom installation consists of the final circuits listed in the box below.

Connected Loads (Without Diversity)

- Lighting circuit No 1: 12 lamps, each rated at 100 W.
- Lighting circuit No 2: 10 lamps, each rated at 100 W.
- Ring final circuit No 1 (downstairs socket-outlets): rated 32 A.
- Ring final circuit No 2 (upstairs socket-outlets): rated 32 A.
- Cooker circuit: 8.5 kW.
- Immersion heater: 2.5 kW.
- Instantaneous electric shower: 9.5 kW.
- Air-condition units: 2 Units, each approximately 5 A.

Using the diversity factors given in Table 1, calculate the:

(i) total connected load (maximum demand without diversity). (7 marks)

(ii) estimated actual maximum demand (after applying diversity). Show all calculations in a logical sequence and state any assumptions made regarding the loading of specific circuits. (10 marks)

Electrical Circuit	Diversity factors
Air-condition units	typically, 100% of the largest + 50% of the others, or 75% of total load
Lighting	66% of the total load
Sockets	100% of largest circuit + 40% of the remainder
Cooker	first 10A + 30% of the remainder
Water heater and electric shower	100% (No diversity)

Table 1 - Diversity factors