GOVERNMENT OF MALTA
MINISTRY FOR EDUCATION, SPORT, YOUTH
RESEARCH AND INNOVATION
DEPARTMENT OF EXAMINATIONS

EXAMINATION FOR AUTHORISATION A

Paper 1

Date: **Monday 27th January 2025**

Time: **15.30 – 17:30 (Two hours)**

This examination paper includes ten questions. Candidates are requested to answer ALL questions clearly indicating the question number of the answered questions.

Write only your Index Number in the space provided in the booklet.

Candidates are requested to answer ALL 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 10 marks.

1. a) State Ohm's Law. **(1 mark)**

   b) Two 18W lamps, rated at 12V, are connected in parallel across a 12V DC battery having an internal resistance of 0.3Ω. The cable combined resistance between the battery terminals and the first lamp is 2Ω. The second lamp is connected in parallel to the first lamp with a cable of the same size and length.

      i) Calculate the resistance of the lamps. **(2 marks)**

      ii) Draw the equivalent circuit showing clearly the battery, internal resistance, lamp resistances (note series cable resistance can be drawn up as a single resistance including feeding and return cable). **(3 marks)**

   c) Calculate

      i) the total current supplied by the battery **(2 marks)**

      ii) the current drawn by each lamp. **(2 marks)**

2. The water in an 80 Litre water-heater is to be heated from a temperature of 20^{o} C to 75^{o} C within 120 minutes. The single-phase immersible water heater element is rated 230V AC.

   a) Calculate the amount of heat energy required to heat up the water.
   Assume that the specific heat capacity of water is 4200J/kg/K and the density of water is 1.0kg/m^3. **(4 marks)**

   b) If the effective efficiency of the heater element is 98%, what is the power rating of the heater element? **(4 marks)**

   c) Calculate the current drawn by the water heater if the supply measured voltage is 230V AC. **(2 marks)**

3. a) With the aid of diagrams explain briefly the difference between

      i) a single-phase double wound transformer **(2 marks)**

      ii) and a single-phase auto transformer. **(2 marks)**

   b) State the secondary voltage equation in terms of the primary voltage and the number of turns. **(2 marks)**

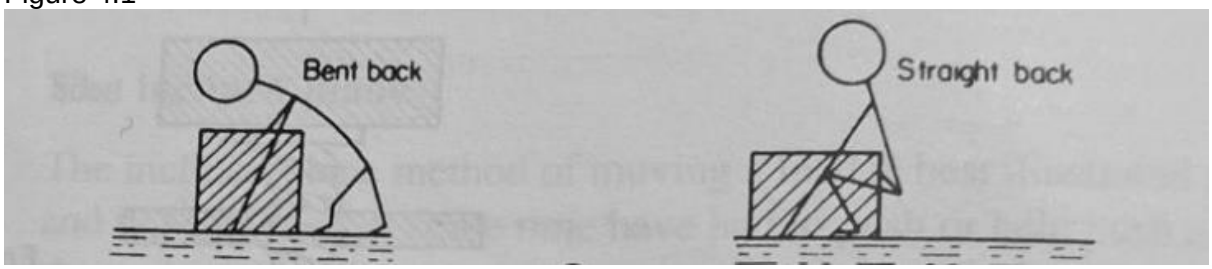
   c) State the secondary current equation in terms of the primary current and the number of turns. **(2 marks)**

   d) Identify the losses in a practical transformer. **(2 marks)**

4. a) Write the number to be called for all emergency services in Malta. **(1 mark)**

b) The following Figures (4.1, 4.2 and 4.3) show correct and incorrect ways of handling different loads. For each figure state the letter that shows the correct and safe way to move the load.

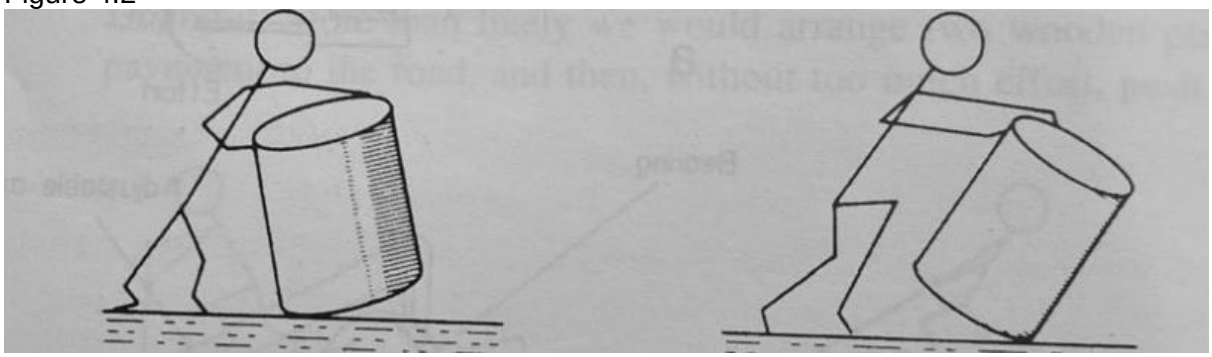
Figure 4.1



A **B**

(1 mark)

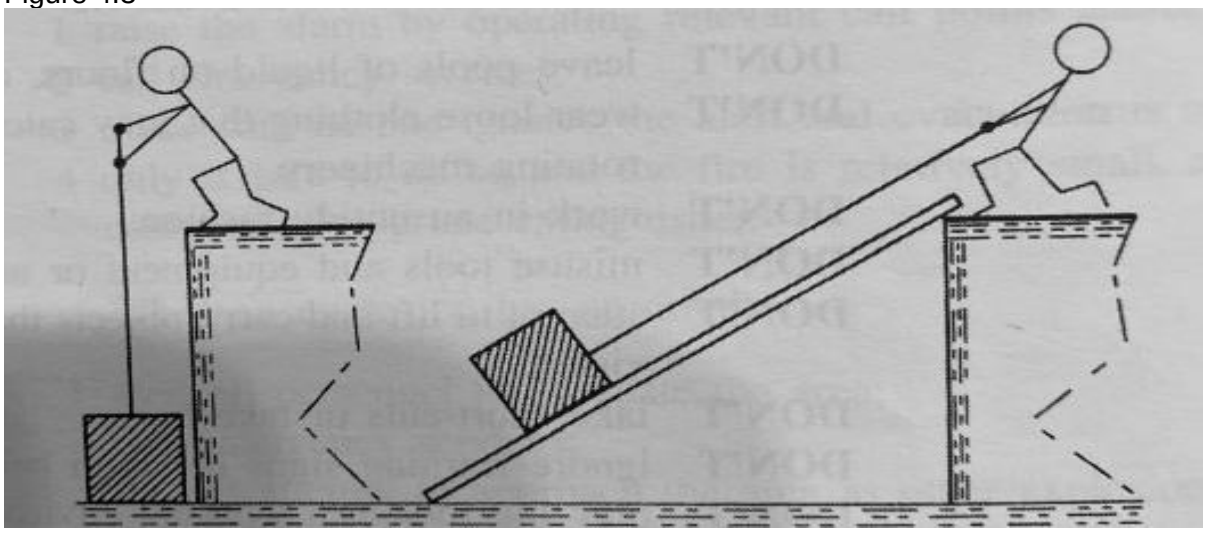
Figure 4.2



C **D**

(1 mark)

Figure 4.3



E **F**

(1 mark)

c) When using a certified ladder to work at heights greater or equal to 3m, state one action that a person
   i. must do **(1 mark)**
   ii. avoid doing. **(1 mark)**

d) Mention two steps an electrician must do to guarantee safety when working on a final circuit. **(2 marks)**

e) Which two of the following fire extinguishers are suitable to put off fire generated by an electrical equipment?

Water	CO_2	Foam	Dry Powder

(2 marks)

5. Malta's local electricity distribution system network operates at the nominal standard voltages.

a) State the nominal low voltage value for both the single-phase and three-phase used to supply residential buildings. **(6 marks)**

b) What is the voltage tolerance range accepted by Malta's distribution system network? **(2 marks)**

c) State the nominal frequency used for the distribution system voltage in Malta. **(2 marks)**

6. a) Define the term Maximum Demand (MD). **(2 marks)**

b) Calculate the maximum demand of a 230V single-phase 8kW shower heater. Assume unity power factor. **(3 marks)**

c) A 230V domestic cooker has the following connected loads:

Top oven	1.5kW
Main Oven	2.5kW
Grill	2.0kW
Four (4) hotplates	1.5kW each

The cooker control unit has a 13A socket outlet.

Diversity for household Cookers:

10A + 30% of remainder of the total connected load + 5A for socket.

Calculate a suitable rating for the protective device. **(5 marks)**

7. a) Draw a neat wiring diagram describing a three-way lighting circuit. For clarity the earth wire can be omitted. **(3 marks)**

b) With the aid of neat diagrams explain the difference between a RING and a RADIAL circuit in a residential installation. **(7 marks)**

8. For a given load the following test instruments are used to obtain the relative measurements. For each of the following instruments and with the aid of a circuit diagram, explain briefly how to connect the testing instruments (assume a single-phase supply of 230V, 50Hz)

a) Voltmeter **(2 marks)**

b) Clamp meter **(2 marks)**

c) Power factor meter **(2 marks)**

d) Ohmmeter **(2 marks)**

e) Insulation resistance meter. **(2 marks)**

9. A client requested to re-certificate an old electrical installation. There are various inspections and tests that can be done.

The table below (Table 9.1) describes the material used for an electrical installation having a copper earth electrode.

a) Copy the Table 9.1 and for each test indicate with an 'X' if the statements Pass or Fail the test/observation done.

Table 9.1

	After inspection/testing observations	**Pass**	**Fail**
1	The diameter of the copper earth electrode is 9 mm.		
2	The length of the copper earth electrode is 2.1metres.		
3	Bentonite surrounding the earth electrode is very dry.		
4	The earth continuity PVC insulated cable CSA connected to the copper earth electrode is 16mm^2.		
5	The resistance reading of the copper earth electrode is 150 Ohms		

(5 marks)

b) List five tests that need to be carried out before the supply is connected. **(5 marks)**

10. A forty-year-old electrical installation is required to be re-certified after the balcony, kitchen/living and bathroom were partially rewired.

a) List four conditions under which the existing old steel conduit may be used. **(4 marks)**

b) It is not recommended to reuse the old wires for part of the new installation. List four reasons for this. **(4 marks)**

c) State the recommended period for re-testing. **(2 marks)**

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