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

EXAMINATION FOR THE ISSUE OF A LICENCE TO ACT AS WIREMAN

Authorization A

Sample Paper II **Time: 3 Hours**

This examination paper contains six (6) questions. Candidates are requested to answer any FIVE (5) questions. They are also requested to include all their work in the booklet provided. All answers should include all workings, any necessary diagrams, and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. a. State Ohm's Law. **(2 marks)**

b. Refer to **Figure 1** below. For the circuit shown in **Figure 1** calculate the following:
(i) The value of the resistor R_x such that the total power dissipated in the circuit is 2.5 kW. **(8 marks)**
(ii) The current flowing in each of the four resistors. **(10 marks)**

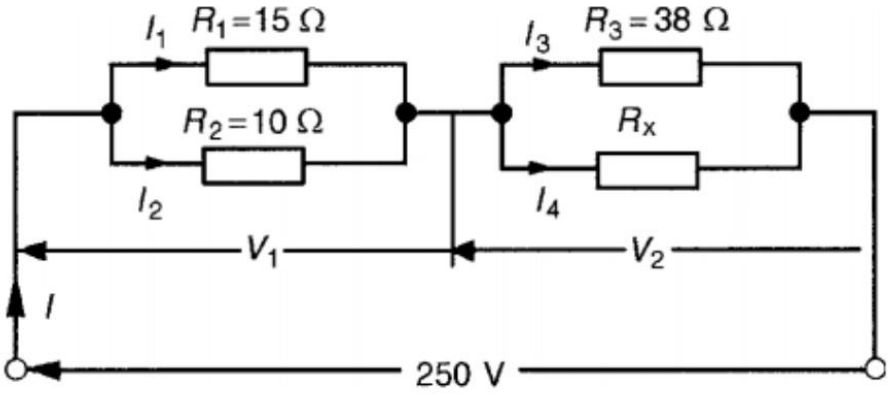

Figure 1

2. A capacitor C is connected in series with a 40 Ω resistor across a supply of frequency 60 Hz. A current of 3 A flows and the circuit impedance is 50 Ω.

a. Draw a well labelled diagram for the configuration. **(2 marks)**

b. Calculate the following:
(i) the value of capacitance C **(4 marks)**
(ii) the supply voltage **(3 marks)**
(ii) the phase angle between the supply voltage and current **(3 marks)**
(iv) the p.d. across the resistor **(3 marks)**
(v) the p.d. across the capacitor **(3 marks)**
(vi) Draw the phasor diagram **(2 marks)**

3. a. List the tests to be carried out on completion of a new installation. **(5 marks)**

b. Why a correct test sequence is necessary when testing an installation. **(3 marks)**

c. With the aid of diagrams describe how you would carry out the following tests on a completed installation. Indicate the instruments used to perform the tests.
(i) Ring- circuit continuity test **(4 marks)**
(ii) Insulation Resistance test **(4 marks)**
(iii) Earth Electrode test **(4 marks)**

4. a. Outline the IET regulations relating to domestic ring circuits using BS1363 Socket-Outlets. **(5 marks)**

b. Draw a neat circuit diagram to show the connections, polarity, size of cables and rating of circuit protective devices of a domestic ring circuit consisting of:
(i) Four 13 Amp socket outlets on the ring. **(5 marks)**
(ii) Two 13 Amp socket outlets connected on the ring as spur. **(5 marks)**
(iii) One 1.5 kW fixed appliance connected to the ring by a switched fused spur box. **(5 marks)**

5. An owner of a flat is to install a solar water heater on the roof of the building. His flat is in 1st floor, while the building is 10 storeys high. The only access between the flat and the roof is through a service shaft. The solar water heater has a heating element rated 4kW, 230V 50Hz. This is to be supplied by a dedicated circuit fed from the flat Consumer Unit. The cable route length between the Consumer Unit and the solar water heater is 50m. This cable will be grouped with another five (5) cables of the same type. The cable to be used is a 3-core XLPE copper sheathed cable and is to be clipped to the wall in the service shaft. The ambient temperature is expected to reach 400C. Additional information is given in tables below.

a. Calculate:
(i) the load current **(2 marks)**
(ii) the MCB rating **(1 marks)**
(iii) the minimum current capacity of the required cable **(3 marks)**
(iv) the size of cable **(2 marks)**
(v) the voltage-drop at the solar water heater terminals and check if this is within limit or not. **(2 marks)**

b. Following some months into operation the owner informs you that the dedicated MCB for the solar water heater is tripping after the heater is working for 30 minutes but the RCD is not tripping.
(i) What type of fault do you expect to find and state why it takes 30 minutes to trip? **(3 marks)**
(ii) Describe how you would proceed to find the fault. **(3 marks)**
(iii) Using the MCB characteristic curve obtain the expected fault current and calculate the fault impedance. **(4 marks)**

Table 3.1 Type C MCB Rating

10A	16A	20A	32A	40A

Table 3.2 Grouping Factor

No of Circuits	1	2	3	4	5	6	7
C_g	1.0	0.8	0.7	0.65	0.6	0.57	0.54

Table 3.3 3-core XLPE sheathed cable

Ambient temperature (^{0}C)	25	30	35	40	45	50	55	60
C_a	1.02	1.0	0.96	0.91	0.87	0.82	0.76	0.71

Table 3.4 Multicore 90^0C sheathed copper cables – Method C		
Cross Sectional Area mm^2	Current carrying capacity (A)	Voltage drop mV/A/m
1	19	46
1.5	24	31
2.5	33	19
4	45	12
6	58	7.9
10	80	4.7
16	107	2.9

6. The phase terminal inside a 1.5 kW electric toaster develops an earth fault to the metal frame of the toaster. The earth fault resistance when measured at the toaster plug is found to be 5ohms. The appliance is supplied from a 230V a.c. supply and the only protection is by a 10Amp fuse. The earth loop impedance at the socket where this appliance is connected is measured as 15 Ω.

   a. Draw an equivalent circuit diagram for this fault and show the current paths under fault conditions. **(5 marks)**
   b. Calculate the fault current. **(4 marks)**
   c. Calculate the voltage on the metal frame if the earth resistance is 10 Ω. **(4 marks)**
   d. From your calculations state if the toaster protection operates at this fault conditions and if it is safe to use the appliance. **(4 marks)**
   e. If it is not practically possible to lower the earth circuit resistance what additional protection is required? **(3 marks)**

TOTAL: 100 marks