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.

Answer any **FIVE** Questions

1a) Explain the basic principle of electrode water heating. (3 marks)

b) Can the heater be supplied from a direct current supply? Give reason for your answer. (2 marks)

c) Using a diagram outline the three main requirements of the IEE Regulations regarding three-phase electrode heaters fed from a low-voltage supply. (9 marks)

d) Using a diagram outline the two main requirements of the IEE Regulations regarding three-phase electrode heaters fed from supplies exceeding low-voltage. (6 marks)

2a) Describe a trunking system as applicable to electrical installations. (3 marks)

b) Explain how metal and non-metal trunking in a trunking system is installed. (3 marks)

c) Give four (4) advantages of a trunking system when compared to conduit system. (4 marks)

d) Describe a flame proof installation and give one application for each zone mentioned. (10 marks)

3. Draw the following circuit diagrams.

a) A single phase split phase induction motor. (4 marks)

b) A three phase wound rotor induction motor. (4 marks)

c) An auto-transformer starter. (4 marks)

d) DC shunt motor starter. (4 marks)

e) Direct on line starter. (4 marks)

4a) What is the difference between a copper conductor and an aluminium conductor used for current carrying conductor? (2 marks)

b) Copy and complete the following table which shows the various types of cable insulation used in different type of installations. (5 marks)

Type of Insulation	Abbreviation	Application
Impregnated Paper	I P	High Voltage Installation
Ethylene Propylene Rubber		
Polyvinyl Chloride		
	XLPE	
Polychloroprene		
	M I M S	

c) With the aid of diagrams draw a soldered type cable lug and crimping type cable lug. (2 marks)

d) What is the difference between steel wire armoured and steel tape armoured cable? (2 marks)

e) A Contractor's Workshop storeroom is filled with three types of cables.
   i) PILSWA cable.
   ii) XLPE armoured cable.
   iii) MIMS cable.

You are requested to select the proper cable to give a supply to a Supermarket. With the aid of diagrams show how you install and route overhead the 50 metres of cable from the sub-station to the supermarket switch room. You also requested to show the **termination of** the selected cable into the main control switch-gear using, a gland and lugs. The earth connection method shall be clearly shown from the gland on to the panel enclosure. (9 marks)

5. A factory having a total load of 200kVA at 400V 50Hz and 0.8 lagging power factor, is to be supplied by means of an underground cable from a nearby 11kV/400V utility substation.

a) Draw a single line diagram showing the substation equipment up to the main switchgear of the factory. (5 marks)

b) The factory switchgear is to be equipped with a measuring panel. The following are available:

- A three-phase voltage transformer (VT) having a ratio of 40:1
- three (3) current transformers (CT) having a ratio of 300:5
- Two selector switches, one for the voltage and one for the current
- One voltmeter
- One ammeter

i) Calculate the voltage across the voltmeter terminals. (2 marks)

ii) If the ammeter has a full scale deflection (FSD) of 1A and the coil resistance is 0.025 ohm, calculate the resistance required so that the 300/5 CTs can be used. (3 marks)

iii) Draw a circuit diagram using the available equipment so that the phase voltages and line currents are measured using the two selector switches. (10 marks)

6a) i) What is prospective earth fault current? (4 marks)

ii) If the prospective fault current rating of a 16Amp Miniature Circuit Breaker (M.C.B) is 6kA and another 16Amp Miniature Circuit Breaker is 20kA. Explain the effects of the two MCB under a high prospective earth fault current of 19kA. (4 marks)

b) The metal enclosure of a Distribution Board is directly connected to the earth electrode. A 400V three phase, 50Hz, TT system supply.

i) What is the excepted voltage if a live conductor connects to the metal and all the safety protection devices do not operate? Draw a circuit diagram showing the current flow and voltage potential. (4 marks)

ii) Explain the test that should be carried out for the earth fault loop impedance. (4 marks)

iii) What conditions of the earth fault loop impedance (Zs) and tripping current, to cause automatic disconnection of the device (Ia), must be fulfilled according to the I.E.E. regulation where an over current protective device is used. (4 marks)

END OF PAPER

EXAMINATION FOR THE ISSUE OF A LICENCE TO ACT AS WIREMAN - LICENCE 'B'

Paper II (Electrical Installation Technology)

Time Allowed: 3 Hrs

July 2013