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071305T4EOP

ELECTRICAL OPERATOR LEVEL 5

ENG/OS/PO/CR/06/5

INSTALL SOLAR SYSTEM

July/August 2024

Time: 3 Hours

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

3 HOURS

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INSTRUCTIONS TO CANDIDATE;

1. This paper consists of **TWO** sections: **A** and **B**
2. Answer **ALL** questions in section **A** and **THREE** questions in section **B** in the answer booklet provided.
3. Marks for each question are as indicated in brackets.
4. Do not write on the question paper.
5. Answer questions in **English**

This paper consists of FOUR (4) printed pages

Candidate should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

*Answer **all** questions in this section*

1. The tilt angle is described as the vertical angle of your solar panel. Explain **three** purposes of "tilt angle" in the installation of solar panels. (3 marks)
2. Most solar electric systems use charge controllers.
   a) State **three** functions of a charge controller in a solar PV installation. (3 marks)
   b) State **two** types of charge controllers. (2 marks)
3. The low battery LED notifies the user that the battery is in a low state of charge. State **three** causes of solar battery having a low state of charge during the day. (3 marks)
4. Proper installation using the right tools ensures that solar systems are reliable and durable. List **four** tools used in cable terminations in a solar PV installation. (4 marks)
5. Labeling cables and conduits is a standard practice in various industries. State **five** purposes of labeling cables in solar PV installation. (4 marks)
6. The average solar panel output per m^2 is 186 kWh per year. State **four** factors that affect the changes in the output of solar cell modules. (4 marks)
7. The national electrical code (NEC) specifies the minimum requirements for wire for house wiring size. Explain the following as used in cable size selection
   a) Permissible voltage drop.
   b) Ambient temperature. (4 marks)
8. Maintaining solar batteries efficiently is crucial to optimizing their lifespan and performance. State **five** tasks involved in maintaining and managing solar batteries. (5 marks)
9. The PV Module is one of the most vital components of a solar PV system. Outline **five** procedures of maintenance of a PV solar module. (5 marks)
10. As an electrician you are required to verify the polarity of all circuits before connection to the supply. Explain **three** reasons for carrying out polarity test in an electrical installation. (3 marks)

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SECTION B (60 MARKS)

*Answer **THREE** questions in this section. All questions carry equal marks.*

11. Understanding and appropriately accounting for both irradiance and diffuse radiation are essential for designing, sizing, and optimizing solar energy systems to maximize energy production and overall performance under varying environmental conditions.

a) Define the following solar terminologies:

i. Irradiance.

ii. Diffuse radiation. (4 marks)

b) A 12 V d.c. solar system supplies three 10W lamps and 60W television for 6 hours and 4 hours respectively in a day. Assuming no system losses, determine

i. Total daily energy demand

ii. Daily system charge requirement. (6 marks)

c) Solar Photovoltaic (PV) systems generate electricity from sunlight collected by solar panels. Explain five factors taken into consideration when mounting solar module. (10 marks)

12.

a) Earth continuity test should be done periodically as part of regular maintenance. Describe the procedure of measuring the resistance of earth continuity conductors. (4 marks)

b) Solar batteries, also known as solar energy storage systems or solar battery storage, are devices that store excess electricity generated by solar panels during periods of high sunlight intensity for later use when sunlight is unavailable, such as during the night or during cloudy weather. Explain the following conditions which occur in the solar batteries.

i. Sulphation

ii. Stratification. (6 marks)

c) Several instruments are used to measure various parameters related to solar photovoltaic (PV) systems to assess their performance, efficiency, and overall health. Name **five** measuring instruments used in PV system maintenance and State functions of each. (10 marks)

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13.

a) Cable sizes are selected by their current carrying capacity. State two factors affecting current carrying capacity of cables. (2 marks)

b) Determining the appropriate cable size for a particular load ensures that the cable can safely carry the required current without overheating or voltage drop. Outline the procedures of determining the current cable size for a particular load. (8 marks)

c) Greenhouse effect in solar harvesting optimizes the capture and retention of solar energy within a confined space, increasing the efficiency of solar heating systems.

With the aid of a diagram, explain the "green house" effect as used in harvesting solar energy. (10 marks)

14.

a) Initial verification involves confirming that the installation adheres to relevant electrical regulations, standards, and specifications. State **three** reasons for conducting initial verification before testing. (3 marks)

b) Solar electricity is increasingly being adopted by businesses and industries in Kenya. Outline **five** applications of solar electricity in Kenya. (5 marks)

c) Choosing the location for solar batteries involves several considerations to ensure optimal performance and efficiency: Explain each of the following factors considered when choosing a battery location.

i. Nearness to the controller
ii. Ventilation
iii. Security and safety
iv. Temperature
v. Accessibility (12 marks)

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